St. George STP 021-1(36) Scoping Study Report

St. George, Vermont

March 17, 2023

Prepared for:

Vermont Agency of Transportation

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Sean Neely

Reviewed by Santy, Gary Digitally signed by Santy, Gary Date: 2023.03.18 08:03:43 -04'00'

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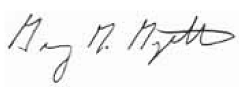
Approved by  Digitally signed by Goyette, Gregory Date: 2023.03.20 09:07:00 -04'00'

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Greg Goyette

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1.0 EXECUTIVE SUMMARY

The intersection of VT 116 and VT 2A in St. George lies along the commuter corridor serving residents from Hinesburg and Huntington traveling to Burlington, South Burlington, and Williston. The intersection has a history of frequent crashes, excessive speeding, sight line issues and capacity constraints during the peak travel hours of the day. This scoping study reviewed existing information, received input from residents, established a Purpose and Need statement, and developed a list of improvement alternatives. Alternatives were evaluated by how well each addressed the Purpose and Need. Subsequently, a select list of four alternatives were presented to the public. After receiving public input and discussing alternatives with the project team, including the Vermont Agency of Transportation (VTrans) and the Chittenden County Regional Planning Commission (CCRPC), a preferred alternative was selected.

The preferred alternative is Alternative D: Roundabout. This alternative includes replacing the existing stop-controlled intersection configuration with a modern three-legged single lane roundabout. Based on the analysis, constructing a roundabout here is expected to improve safety, reduce the frequency and severity of crashes, reduce vehicle speeds, improve sight lines, and reduce delays.

2.0 INTRODUCTION

This study was commissioned by VTrans in response to safety concerns at this intersection. The intersection of VT 116 and VT 2A in St. George was identified as a high crash location in the 2010-2014 High Crash Location Report. VTrans then conducted a Road Safety Audit for this location in November 2016. Now the VTrans project definition process is being applied to develop recommended safety improvements. Steps in this process include: defining the project purpose and need; analyzing intersection operations; developing and evaluating alternative improvement strategies; engaging the public; and selecting a preferred alternative.

3.0 PURPOSE AND NEED

Purpose: The purpose of this project is to construct improvements that improve safety, reduce the frequency and severity of crashes, reduce vehicle speeds, improve sight lines, and reduce delays at the VT 116 and VT 2A intersection.

Need: Recognizing the importance of this intersection in the transportation system for the Town of St. George and the surrounding communities, the following needs for the project have been identified:

1. *There is a need to mitigate factors that contribute to a high number of crashes:* This location is identified as a High Crash Location, with 16 crashes during the 2011-2015 period and 18 crashes during the 2012-2016 period.
2. *There is a need to mitigate existing vehicle speeds:* The posted speed limit on VT 116 is 40 mph. Results from a 2016 VTrans speed study on this portion of VT 116 indicated an 85th percentile speed of 48 mph and a 90th percentile speed of 49 mph. Additionally, VT 116 and VT 2A are High

Use / High Priority bicycle corridors for the VTrans On-Road Bicycle Plan. As part of that plan, each approach of this intersection scored differently for Bicycle Level of Comfort, indicating opportunities for improvement to increase the bicycling comfort for all ages and abilities.

3. *There is a need to improve existing sight lines:* Based on the 2016 VTrans Road Safety Audit Review (RSAR), existing sight lines of on-coming traffic are obstructed for motorists turning from VT 2A due to northbound vehicles in the right-turn lane on VT 116.
4. *There is a need to address existing delays at the intersection during peak travel periods:* Local concerns from the RSAR expressed that traffic backs up significantly on the VT 2A approach and that traffic on VT 116 is sometimes heavy with few gaps. VTrans Traffic Research found two signal warrants were met, based on their signal warrant analysis using the 2009 Edition of the Manual on Uniform Traffic Control Devices (MUTCD).

4.0 EXISTING PLAN AND STUDY REVIEW

Plans and studies reviewed for the preparation of this scoping study are listed and summarized below.

- VTrans Road Safety Audit Review (2016)
- St. George Town Plan (2018)
- Vermont Highway Safety Plan (2017-2021)
- 2040 Vermont Long-Range Transportation Plan (2018)
- VTrans Bicycle and Pedestrian Strategic Plan (2021)

4.1 VTRANS ROAD SAFETY AUDIT REVIEW, 2016

The VTrans Road Safety Audit Review (RSAR) identified potential safety hazards and physical features that might impact the safety of roadway users at the study intersection, VT 116 and VT 2A in St. George, and proposed possible solutions. The RSAR was performed in the context of VTrans Highway Safety Improvement Program (HSIP). The audit reviewed intersection geometry, motor vehicle speeds, traffic volumes, traffic signs, past projects, future projects, crash history, and current local concerns. The primary safety concern identified was limited sight distance of on-coming traffic due to vehicles in the northbound VT 116 offset right-turn lane. The primary crash pattern is a right-angle crash, representing about half of all crashes, with most of those involving a northbound vehicle and a westbound vehicle turning left onto VT 116 to travel southbound, during either the morning or evening peak periods. About a quarter of all crashes were rear-end collisions, distributed among all three approaches. Local concerns included northbound vehicles entering the right-turn lane at the last second to maintain speeds, long queues on the VT 2A westbound approach, with few gaps in traffic on VT 116, and associated driver impatience.

Proposed possible solutions include:

1. Install rumble strips along the length of the left side of the right-turn storage lane to encourage motorists to enter the turn lane earlier

2. Convert the right-turn lane on VT 116 to an offset right-turn lane to remove sight obstructions

3. Install a traffic signal, supported by a signal warrant analysis conducted by VTrans Traffic Research
4. Construct a roundabout, which the audit team's benefit-cost analysis supported as justifiable due to safety

4.2 ST. GEORGE TOWN PLAN, 2018

The St. George Town Plan states in goal 5.05-A, "To provide for safe, convenient, economic, and energy-efficient transportation systems that respect the integrity of the natural environment, including public transit options and paths for pedestrians and bicyclers. Highways, air, rail and other means of transportation should be mutually supportive, balanced and integrated."

Vermont Routes 116 and 2A have historically served commuter traffic from Hinesburg, Huntington, and the communities in northern Addison County, to Burlington, South Burlington, and Essex. In the past several years, more commuters are also traveling from residences north of St. George to Hinesburg and other places to the south. Truck traffic has also increased on these state highways as more commercial and industrial development has occurred both north and south of St. George (p. 20, Town Plan).

4.3 VERMONT HIGHWAY SAFETY PLAN, 2017-2021

The Vermont Highway Safety Plan (2017-2021) addresses seven critical emphasis areas (CEAs) to improve safety by reducing major crashes. The first two CEAs are emphasized in this scoping study for St. George:

1. Improve infrastructure to minimize lane departure and intersection incidents.

2. Reduce speeding and aggressive driving.

4.4 2040 VERMONT LONG-RANGE TRANSPORTATION PLAN, 2018

The first goal prioritized in the 2040 Vermont Long-Range Transportation Plan is to "improve safety and security across all transportation modes". That goal is addressed in this scoping study, specifically through the first objective developed for in the plan for that goal:

1.1 Reduce the number of crashes on Vermont highways, with a focus on those resulting in a fatality or incapacitating injury.

4.5 VTRANS BICYCLE AND PEDESTRIAN STRATEGIC PLAN, 2021

The VTrans Bicycle and Pedestrian Strategic Plan (BPSP) developed strategies to consider bicycling and walking as part of all VTrans projects and activities. The BPSP is the third phase developed for the VTrans On-Road Bicycle Plan. Phase I estimated bicycling demand on state roads (VTrans Bicycle Corridor Priority Map) and Phase II assessed state roadway conditions for bicycling [Bicycle Level of Comfort (BLOC) Map]. Relevant components of Phases I & II are addressed in the Pedestrian and Bicycle Facilities section (5.5) of this scoping report.

The vision developed for the BPSP states, “The needs of people walking and bicycling of all ages and abilities will be considered in all VTrans activities”. One of the goals developed for the BPSP is to “prioritize network improvements which emphasize safety”. Part of the BPSP high-priority strategies is to annually run the Bicycle Level of Comfort model for the Vermont state road network to track progress in developing a road network that is more comfortable for bicyclists.

5.0 PROJECT AREA AND EXISTING CONDITIONS

The project study area for this scoping report includes the area in the immediate vicinity of the intersection of VT 116 and VT 2A in the Town of St. George, displayed in Figure 1.

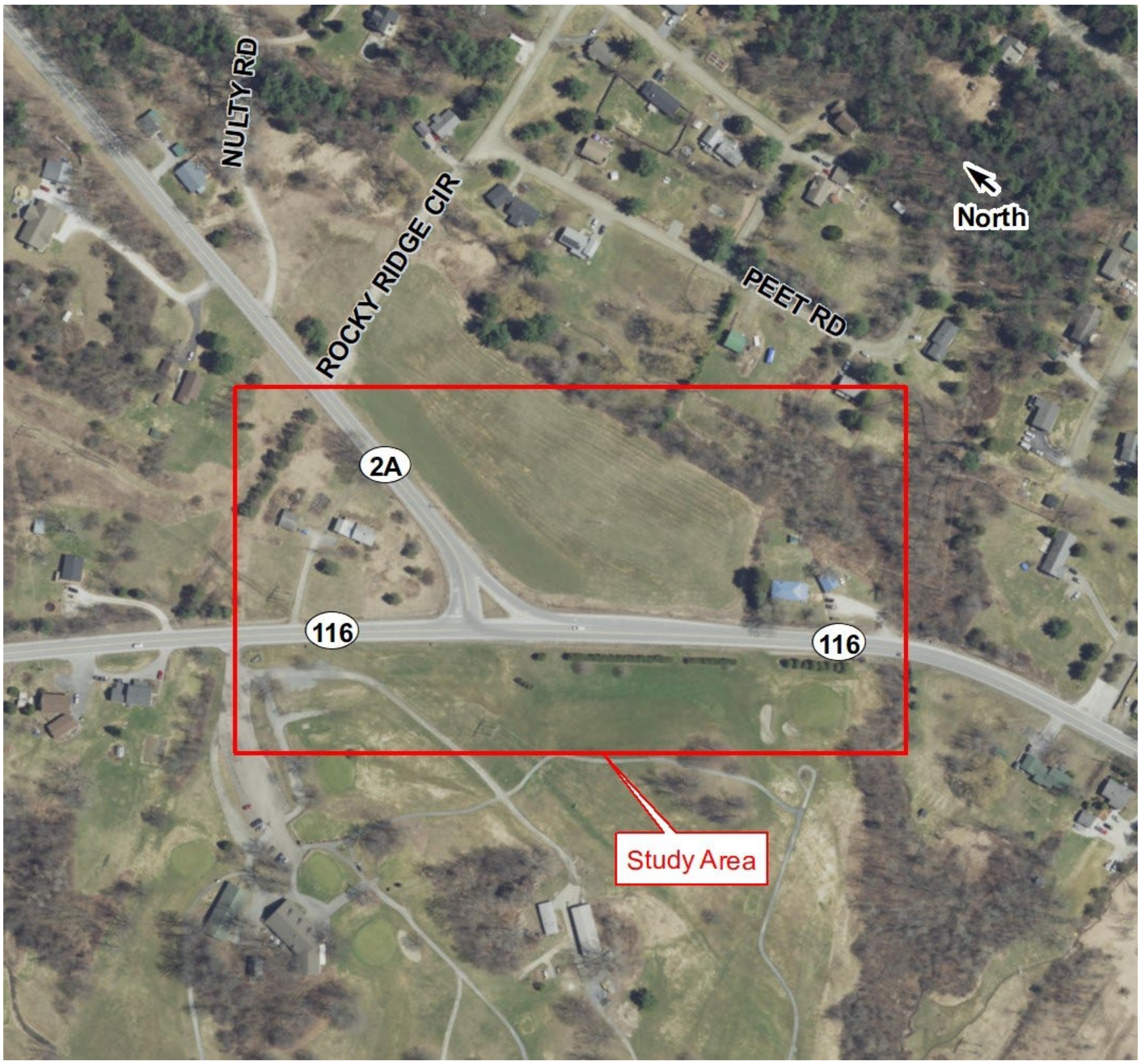


Figure 1: Project Study Area (Esri image)

5.1 ROADWAY CHARACTERISTICS

VT 116 is a two-lane highway with a posted speed limit of 40 mph and 11 FT travel lanes in the study area. Outside of the study area, VT 116 is mostly posted for 50 mph. VT 2A is a two-lane highway with a posted speed limit of 35 MPH and 11 FT travel lanes in the study area. Route logs indicate four-foot shoulders along VT 116 and two to three-foot shoulders along VT 2A in the project area. The study intersection is a T-intersection with VT 2A terminating and stop-controlled at VT 116. The westbound approach has separate lanes for left and right turns, with 100 feet of storage. The northbound approach has a channelized right turn lane with a yield condition for motorists turning right from VT 116 onto VT 2A, a taper length of about 130 feet and a storage length of about 160 feet, per the RSAR. The RSAR noted this storage length is less than the 180 feet recommended by VTrans Standard E-192 for speeds more than 30 mph.

The most recent paving work was completed in 2008 and existing pavement condition is fair and poor. According to VTrans Pavement Design staff, this could indicate a minor level and overlay project could be warranted in the near future, although nothing is currently planned.

5.2 TRAFFIC VOLUMES

Traffic volume data including Annual Average Daily Traffic (AADT) values and peak hour volumes for the study area were collected from VTrans. AADT values collected by VTrans for 2019/2020 and estimated by VTrans for 2025 and 2045 are displayed for the study area in Table 1. Traffic volumes are highest along VT 116 south of the intersection, as much as volumes on VT 2A and VT 116 north of the intersection combined. This reflects the intersection turning movement patterns which show relatively low volumes traveling between VT 2A and VT 116 north of the intersection.

Table 1: Current and Future AADT Volumes

Location	2019	2020	2025	2045
VT 116 North	4,884	4,137	6,600	7,200
VT 116 South	10,671	9,038	11,000	12,100
VT 2A	5,716	4,841	5,300	5,800

Existing weekday commuter peak hour traffic conditions for the study intersection were determined using the latest available data. Traffic volume data are collected periodically by VTrans at intersections in the region. Peak hour turning movement counts were collected for the study intersection by VTrans in June 2015. Those volumes were adjusted to 2021 existing volumes based on the growth factor 1.04 specified by VTrans in the Continuous Traffic Counter Report ("The Redbook") and presented in Appendix 1.

5.3 INTERSECTION OPERATIONS

Intersection operating levels of service (LOS) have been calculated for the intersection of VT 116 and VT 2A based on the traffic volume, roadway geometry, and traffic control data presented above.

LOS is used to describe the quality of the traffic flow on a roadway facility at a particular point in time. It is an aggregate measure of travel delay, travel speed, congestion, driver discomfort, convenience, and safety based on a comparison of roadway system capacity to roadway system travel demand. Operating levels of service are reported on a scale of A to F, with A representing the best operating conditions with little or no delay to motorists, and F representing the worst operating conditions with long delays and traffic demands sometimes exceeding roadway capacity.

Intersection operating levels of service are calculated in accordance with procedures defined in the *Highway Capacity Manual*, published by the Transportation Research Board. For unsignalized intersections, the operating level of service is based on travel delays. Delays can be measured in the field but generally are calculated as a function of the following: traffic volume; peaking characteristic of traffic flow; the percentage of heavy vehicles in the traffic stream; type of traffic control; the number of travel lanes and lane use; intersection approach grades; and pedestrian activity. Through this analysis, volume-to-capacity ratios can be calculated for individual movements or the intersection overall. A volume-to-capacity ratio of 1.0 indicates that a movement or intersection is operating at its theoretical capacity. The specific delay criteria applied per the *Highway Capacity Manual 6th Edition* to determine operating levels of service are summarized in Table 2.

Table 2: Unsignalized Intersection Level of Service Criteria

Level of Service	Average Delay per Vehicle (Seconds)
A	≤10.0
B	10.1 to 15.0
C	15.1 to 25.0
D	25.1 to 35.0
E	35.1 to 50.0
F[1]	>50.0

[1]Level of Service F is also assigned if the volume-to-capacity ratio exceeds 1.0 for a specific movement or lane group. For approach-based and intersection assessments, LOS is defined solely by delay. (Source: *Highway Capacity Manual, 6th Edition*, Transportation Research Board, National Academy of Sciences, Washington, DC, 2016.)

The intersection peak hour operating levels of service were calculated using the *Highway Capacity Manual 6th Edition* methods as applied by the Synchro software package. Analysis results for existing conditions are reported in Table 3 for calculated 2021 volumes. The intersection is over capacity during the PM peak period, due to the large number of vehicles turning left from VT 2A onto VT 116 southbound. If left unmitigated, this condition will worsen in the future. Capacity analysis worksheets are presented in Appendix 2.

Table 3: Existing Intersection Capacity Analysis Results

				2021 (Grown from 2015 TMCs)		
	Control	Condition	Peak Hour	LOS[1]	Delay[2]	V/C[3]
VT 2A	Stop	WB Left	AM	C	20.7	0.39
			PM	F	138.4	1.15
VT 116	Free	SB Left	AM	A	8.6	0.02
			PM	A	7.7	0.03

[1] LOS= Level of Service
[2] Delay = Average delay expressed in seconds per vehicle
[3] V/C = Volume-to-capacity ratio for critical movements

5.4 LAND USE AND ZONING

The land surrounding the subject intersection is zoned as Medium Density Residential. A golf course lies westerly of the intersection on an 86-acre parcel, a single-family residence lies northerly of the intersection on a two-acre parcel, and an open field lies easterly of the intersection on a four-acre parcel. The golf course driveway is about 300 feet northwesterly of the intersection. The single-family residence northerly of the intersection has two driveways: one accesses VT 116 about 250 feet from the intersection, the other access VT 2A about 275 feet from the intersection. There are no known development or redevelopment plans for these parcels.

5.5 PEDESTRIAN AND BICYCLE FACILITIES

No dedicated pedestrian or bicycle facilities currently exist along VT 116 or VT 2A in the project area. Route logs indicate four-foot shoulders along VT 116 and two to three-foot shoulders along VT 2A in the project area. The segments of VT 116 and VT 2A in the project area are identified as High Use / High Priority bicycle corridors on the VTrans On-Road Bicycle Priority Map, developed as part of Phase 1 of the VTrans On-Road Bicycle Plan, to quantify bicycle use along state roads. Phase 2 of the On-Road Bicycle Plan included developing an online Bicycle Level of Comfort (BLOC) Map, scoring roadway segments on a four-point scale of bicycle comfort. A score of 1 indicates the most comfort for bicyclists and a score of 4 indicates the least comfort for bicyclists. Approaches to the study intersection each scored differently, as shown in Table 4.

Table 4: Bicycle Level of Comfort

Segment	Bicycle Level of Comfort Score
VT 116 North of VT 2A	2 – Comfortable for most adult bicyclists
VT 116 South of VT 2A	4 – Uncomfortable for most bicyclists
VT 2A	3 – Comfortable for experienced and confident bicyclists

These classifications from the VTrans On-Road Bicycle Plan indicate that while the roadway segments in the study area are high priority segments in the statewide on-road bicycle network and receive high use from bicyclists, improvements should be considered to increase the bicycling comfort for all ages and abilities.

5.6 TRANSIT SERVICE

The Green Mountain Transit (GMT) #46 VT Route 116 Commuter Shuttle typically operates along VT Route 116 between Burlington and Middlebury, passing through the subject intersection. Hourly service is typically provided during weekday commuter peak periods. Service is currently suspended due to the Covid pandemic. Tri-Valley Transit (TVT) [formerly Addison County Transit Resource (ACTR)] runs a VT Route 116 Commuter Shuttle between Burlington and Middlebury that also passes through the subject intersection on VT 116 during weekday morning and afternoon commuter peak periods. Neither route includes a stop at the VT 116/VT 2A intersection.

5.7 CRASH HISTORY

Sources of crash data were reviewed, including the Road Safety Audit Review (RSAR) (2011-2015), the VTrans list of High Crash Locations (2012-2016), and the Vermont Public Crash Data Query Tool (2017-2020).

<u>Road Safety Audit Review</u> (2011-2015)

Sixteen crashes were reported for the study area during this five-year period (2011-2015). The collision diagram from the RSAR report is displayed below. Right-angle crashes were the most common crash type with most of these crashes involving a northbound, through vehicle on VT 116 and a left-turning vehicle from VT 2A. Most crashes occurred during morning or evening peak hours. The second most prevalent crash type was rear-end collision. Crashes of this type were observed on all intersection approaches. The RSAR documents limited sight distance of on-coming traffic due to vehicles in the right turn lane; northbound vehicles on VT 116 in the right turn lane are obstructing the view of northbound through vehicles on VT 116 for motorists making a left turn from VT 2A to travel southbound on VT 116.

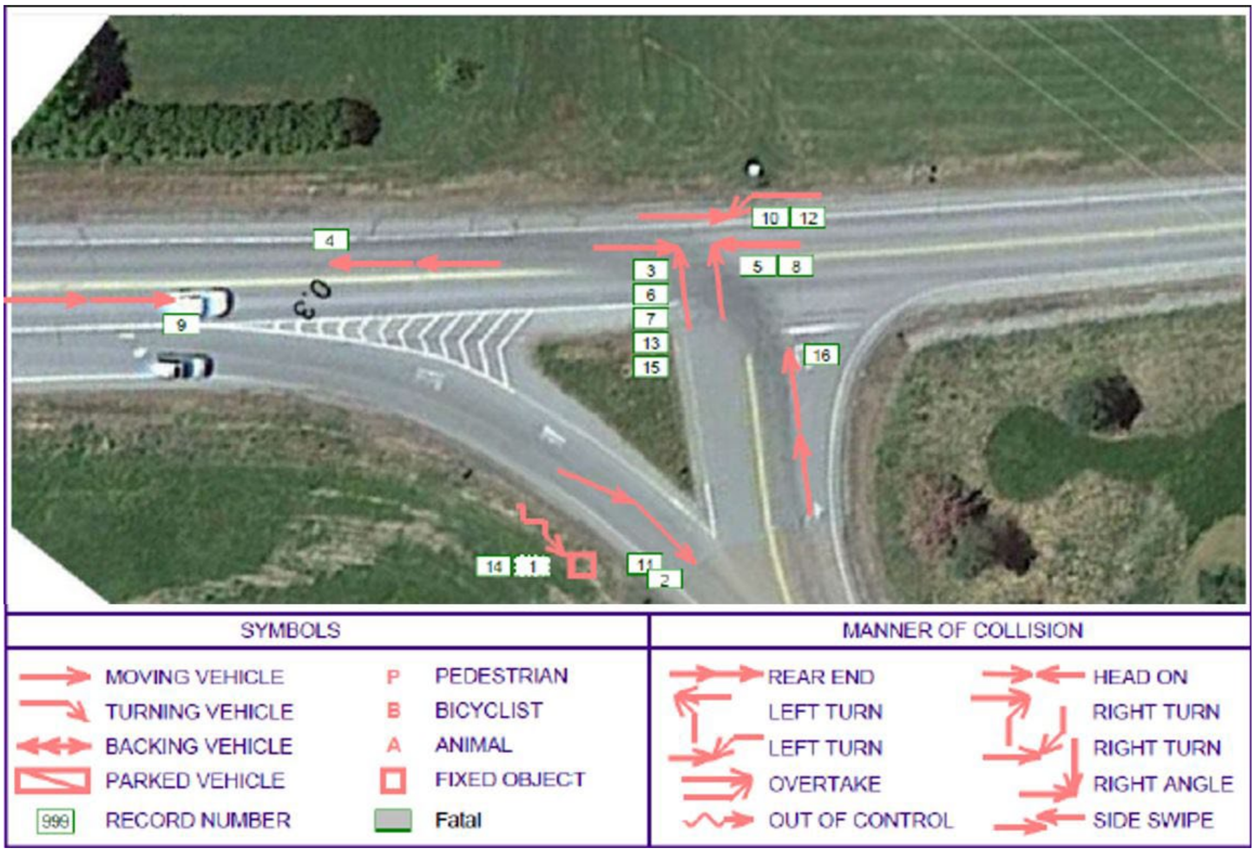


Figure 2: Collision Diagram (RSAR)

<u>High Crash Location List</u> (2012-2016)

VTrans maintains a listing of High Crash Locations (HCL) within the state. A 0.3-mile highway segment or intersection must have at least five crashes over a 5-year period and the actual crash rate (number of crashes per million vehicles at an intersection or per million vehicle miles along a segment) must exceed a critical crash rate to be classified as an HCL. The critical crash rate is based on the average crash rate for similar highways. The most recent compilation of the crash data, "*VTrans High Crash Report: Sections and Intersections 2012-2016"* lists the 1500 FT section of VT 116 that includes the intersection with VT 2A as an HCL section. As presented in Table 5, seven injuries and no fatalities were included with the 18 crashes listed for this highway section, ranked 137 out of 800 HCL sections in the state. The intersection itself was not listed as an HCL intersection, as it did not meet both the criteria of having five or more crashes per year and having the actual crash rate be greater than the critical crash rate.

Table 5: High Crash Locations 2012-2016

Cross Streets	HCL No.	Mile Marker	AADT	Crashes	Fatalities	Injuries	Actual/ Critical Ratio	Severity Index
~1100' north of VT 2A To ~400' south of VT 2A	137	0.240 - 0.540	6,154	18	0	7	2.013	$42,578

Public Crash Data (2017-2020)

The crash history for the study area was also investigated by Stantec using the VTrans crash database. VTrans keeps records of reported crashes by milepost along State and Federal Aid highways in Vermont. General Yearly Summaries can be requested from VTrans for given roadway segments. The summaries note the location (mile marker), date, time of day, weather conditions, contributing circumstances, and severity for reported crashes. Crash data were reviewed for the study area for 2017 through 2020.

Table 6 provides a summary of the crash data. Records for the project study area show eight crashes on VT 116, with no records for crashes within the limits of the study area on the VT 2A approach during these years. Rear-end crashes and head-on crashes each occurred twice out of the eight. No fatalities were reported and two crashes resulted in personal injury. Only one crash occurred during snow or icy conditions. No crashes involved bicycles or pedestrians.

Table 6: Crash Data Summary

Year	Crashes 2017-2020
2017	2
2018	1
2019	3
2020	2
Total	**8**
Type	
Angle	0
Rear-end	2
Head-on	2
Single Vehicle	0
Sideswipe	1
Broadside; No Turns	0
Unknown/Other	3
Total	**8**
Severity	
Property Damage	3
Personal Injury	2
Fatality	0
Unknown/Other	3
Total	**8**
Weather	
Clear	3
Cloudy	0
Rain	0
Snow/Ice	1
Fog	0
Unknown	4
Total	**8**

5.8 NATURAL RESOURCES

VTrans conducted a natural resource identification, including wetlands, wildlife habitat, agricultural soils, and rare, threatened, and endangered species, summarized here and presented in Appendix 4. The Project Study Area for this review is as shown in Figure 1. Desktop reviews and a site investigation were conducted for each of these features within the Project Area to support the assessment.

Wetlands & Streams

A field visit identified a small wetland near the southeasterly edge of the Project Area, adjacent to the crossing of an unnamed tributary of the westerly flowing LaPlatte River. The wetland is a class II wetland and would require a 50 FT buffer. Any improvements designed for this project will need to avoid and minimize impacts to these resources. If the stream or wetlands are impacted, coordination and permitting will be required through resource regulatory agencies.

Rare, Threatened, and Endangered Species (RTE)

The Agency of Natural Resources (ANR) Natural Resource database was used by VTrans to identify RTE species and significant natural communities within the Project Area. The Project Area is within the summer range of the federally endangered Indiana Bat and the federally endangered northern long-eared bat. No hibernacula or roost tree locations were identified during the desktop review within a mile of the Project Area. No roost tree locations were identified during the field visit.

Wildlife Habitat

Open agricultural land is the predominant land cover in the Project Area. The most valuable habitat in the Project Area is the riparian corridor of the unnamed tributary. According to the ANR's Bio Finder mapping, intact riparian zones are high priority for various aquatic and terrestrial species, in addition to providing water quality, flood attenuation, and erosion prevention. Project improvements should avoid impact to the riparian zone if possible.

Hazardous Material Sites

There are no Hazardous Sites mapped within the Project Area.

Agricultural Soils

The Project Area does not include any prime agricultural soils. Munson and Raynham silt loams make up the soils in the Project Area, classified as Statewide (b).

Invasive Species

No invasive species were found in the Project Area.

5.9 CULTURAL RESOURCES

Historic and archeological resources were evaluated by VTrans. Summaries of the findings are presented in Appendix 5. VTrans Cultural Resources staff used a large preliminary Area of Potential Effect (APE) to include all relevant cultural resources that could be impacted. After conceptual design is completed for the project, Cultural Resources staff will formalize the APE per Section 106 and 22 VSA § 14.

One property in the Project Area was identified as both 4(f) property and historic: 7601 Route 116, House and outbuilding. The property is referred to historically as the Lockwood-Peet House, built in 1830. The property has changed little since it was listed on the State Register of Historic Places in 1993. It is considered a rare surviving property representative of the early agricultural heritage of St. George.

Most of the project area can be considered archaeologically sensitive, except for the immediate areas adjacent to the roadway, including ditches and underground utilities. Further study for areas to be impacted by the preferred alternative is recommended by the VTrans Archaeology Officer.

5.10 UTILITIES

Aerial utilities within a 150 FT wide easement for VELCO run across VT Route 116 approximately 200 FT northwesterly of the intersection. Smaller scale aerial utility lines, which include Comcast and Waitsfield-Fayston Telephone Company, cross VT Route 2A approximately 200 FT northeasterly of the intersection.

Underground utilities are also present in the project area and are owned by Waitsfield-Fayston Telephone Company, Comcast, and Vermont Gas. The Vermont Gas transmission line crosses VT Route 116 on the southerly leg of the intersection.

5.11 DRAINAGE

A VTrans stormwater engineer reviewed existing imagery and mapping for the project area and conducted a site visit for concerns related to stormwater regulations and water quality. It is not yet known if an Operational Stormwater permit will be needed. If it is not, and a Construction Stormwater Permit is needed, the TS4 “Gap” procedure and related post construction treatment measures will be required. No existing stormwater permits are in place near the project site. No formal stormwater treatment is currently within the ROW.

Drainage in the project area includes grass and stone lined swales along with sheet flow into the golf course. Two 15” CMP culverts connect to a drop inlet within the central island of the intersection. These culverts are in poor condition, with a mostly buried outlet and some erosion below the outlet. Drainage from the project area goes south to the unnamed tributary of the LaPlatte River.

Soils in the project area are documented as hydrologic soil group C/D, which are not ideal for infiltration. Sheet flow through vegetation is more suitable for the project area.

5.12 RIGHT-OF-WAY

The Right-of-Way (ROW) along VT Route 116 is a four rod ROW, 66 FT wide. The ROW along VT Route 2A is a three rod ROW, 49.5 FT wide.

6.0 INITIAL ALTERNATIVES

The project team considered a range of improvements to address the project's purpose and need. During the project meetings, various options were discussed. Based on these discussions, the following alternatives were developed and evaluated:

- Alternative 1: Do Nothing
- Alternative 2: Rumble Strip
- Alternative 3: Offset Right Turn Lane
- Alternative 4: Remove Slip Lane; Install Standard Right Turn Lane
- Alternative 5: Realignment, Reassign Priority
- Alternative 6: Add LT Turn Lane for SB VT 116 onto VT 2A
- Alternative 7: Traffic Signal, Existing Geometry
- Alternative 8: Traffic Signal, Modified Geometry (Remove Slip Lane)
- Alternative 9: Roundabout

6.1 ALTERNATIVE 1: DO NOTHING

For the Do Nothing Alternative, the existing transportation facilities in the project area remain as they exist today. This alternative has no construction costs and has no impacts on right-of-way, resources, or traffic. The No Action Alternative does not address the Purpose and Need.

6.2 ALTERNATIVE 2: RUMBLE STRIPS

This alternative proposes adding rumble strips along the left edge of the storage lane for northbound motorists on VT 116 turning right onto VT 2A, to persuade motorists to enter the right turn lane earlier.

6.3 ALTERNATIVE 3: OFFSET RIGHT TURN LANE

This alternative proposes constructing a right turn lane outside of the sight distance triangle for the VT 2A approach. This design mitigates the issue of right turning motorists in the existing storage lane for northbound motorists on VT 116 obstructing the view of northbound through vehicles for motorists stopped on VT 2A.

6.4 ALTERNATIVE 4: REMOVE SLIP LANE; INSTALL STANDARD RIGHT TURN LANE

This alternative proposes to remove the existing channelized right turn slip lane for northbound motorists on VT 116 turning right onto VT 2A, replacing it with a standard right turn lane. This would force motorists turning right onto VT 2A to reduce their speed to make the turn.

6.5 ALTERNATIVE 5: REALIGN; REASSIGN PRIORITY

This alternative proposes to change the alignment of the intersection, reassigning priority based on traffic volumes. VT 116 northbound would transition to a through movement to become northbound on VT 2A. VT 116 southbound would be stop-controlled, with an offset stop bar to maintain visibility for right turning motorists. VT 2A southbound would transition to a through movement to become southbound on VT 116. This configuration reduces the volume of left turning vehicles at the stop condition, improving intersection operation.

6.6 ALTERNATIVE 6: ADD LEFT TURN LANE FOR SB VT 116 ONTO VT 2A

This alternative proposes to add a left turn lane for southbound motorists on VT 116 turning left onto VT 2A. Without a signal, this would add another lane to cross for motorists turning left from VT 2A onto VT 116 southbound, so it may be better with a signal.

6.7 ALTERNATIVE 7: TRAFFIC SIGNAL, EXISTING GEOMETRY

This alternative proposes signalizing the intersection and maintaining existing geometry. VTrans Traffic Research determined that a signal is warranted at this intersection. The signal warrant analysis was conducted using methods presented in the 2009 Manual on Uniform Traffic Control Devices (MUTCD). Results from the analysis indicate the eight-hour minimum vehicular volume warrant and the four-hour vehicular volume warrant are met. A signal warrant analysis was performed again as part of this scoping project, confirming the intersection meets criteria for both the eight-hour minimum volume warrant and the four-hour vehicular volume warrant.

6.8 ALTERNATIVE 8: TRAFFIC SIGNAL, MODIFIED GEOMETRY (REMOVE SLIP LANE)

This alternative proposes signalizing the intersection, modifying intersection geometry by removing the slip lane, and adding advanced warning to help educate motorists about the new signal installation. The existing channelized right turn slip lane for northbound motorists on VT 116 turning right onto VT 2A would be removed, replacing it with a standard right turn lane. This would force motorists turning right onto VT 2A to reduce their speed to make the turn.

6.9 ALTERNATIVE 9: MINI ROUNDABOUT

This alternative proposes converting the intersection to a modern single lane mini roundabout. Roundabouts can provide lasting benefits and value in many ways. They are often safer, more efficient, less costly to maintain, and more aesthetically appealing than conventional intersection designs. The FHWA Office of Safety identified roundabouts as a Proven Safety Countermeasure because of their ability to substantially reduce the types of crashes that result in injury or loss of life.

Where conditions suffice, a mini roundabout can provide safety and operational benefits while costing less to construct and requiring a smaller footprint.

6.10 ALTERNATIVE 10: ROUNDABOUT

Locations that may not work well for a mini roundabout can still benefit from a modern roundabout. Full size modern roundabouts are better suited for isolated locations outside of urban areas, speeds greater than 25 mph, and higher volumes of trucks.

6.11 INITIAL ALTERNATIVE EVALUATION

The initial list of nine alternatives were evaluated based on how well each would meet the Purpose & Need, and what amount of maintenance, environmental impact, and construction cost would be expected. Through this evaluation, this list of ten initial alternatives was reduced to four alternatives to advance for further analysis. The Do Nothing alternative, while it does not meet the Purpose & Need, is advanced as a baseline for comparison. The other three alternatives advanced include:

- Traffic Signal, Existing Geometry
- Traffic Signal, Modified Geometry (Remove Slip Lane)
- Roundabout

The Evaluation Matrix for Initial Alternatives is displayed below.

Stantec

St. George STP 021-1(36) Project Definition: Evaluation Matrix for Initial Alternatives

	Do Nothing	Rumble Strip	Offset RT Lane	Standard RT Lane	Realign, Reassign	LT Lane VT 116	Signal: Existing Geometry	Signal: No Slip Lane, Advance Warning	Mini Roundabout	Roundabout
Sight Distance	No Change	No Change	Better	No Change	Better	No Change	Better	Better	Better	Better
Mitigate Vehicle Speeds	No Change	Better	Better	Better	Unknown	Unknown	Improved for red phase; Green/yellow maybe worse	Improved for red phase; Green/yellow maybe worse	Better	Better
Improve Capacity	No Change	No Change	No Change	No Change	Marginal capacity improvement[1]	VT 116 better; VT 2A worse.	VT 2A better; VT 116 worse	VT 2A better; VT 116 worse	Better	Better
Reduce Crash Factors	No Change	Unknown	Low Impact	Reduce angle crashes	May increase crashes for SB VT 116	May increase crashes for LT	44% Reduction[2]	≥44% Reduction[2] (No slip lane)	71% Reduction	71% Reduction
Maintenance	No Change	Low	Low	Low	Low	Low	Medium	Medium	Medium	Medium
Environmental Impact	No Change	None	Arch sensitivity	None	Arch sensitivity	Arch sensitivity	Low	Low	Arch sensitivity	Arch sensitivity
Construction Cost	None	$	$$	$$	$$	$$	$$$	$$$	$$$	$$$$
Advance to Further Consideration	ADVANCE[3]	ELIMINATE	ELIMINATE[4]	ELIMINATE[5]	ELIMINATE[6]	ELIMINATE	ADVANCE	ADVANCE	ELIMINATE[7]	ADVANCE

[1] VT2A better; VT116 SB worse; Overall marginal capacity improvement
[2] Installing traffic signals where none existed previously often has a crash modification factor (CMF) of 44%, although with a short-term impact of increasing crashes, especially rear ends, while the traveling public gets used to new signal placement
[3] Advance for comparison purposes; does not meet Purpose & Need
[4] No improvement to capacity; does not fully meet Purpose & Need
[5] No improvements to sight distance, compared with offset RT lane; no improvement to capacity; does not fully meet Purpose & Need
[6] Look at merge for VT 116 SB (if capacity issue), with receiving lane for VT 2A SB thru. Not high speed merge; slow down VT 2A traffic with geometry
[7] Isolated location outside urban area, high speeds (> 25mph), high percentage of trucks (Naik, Bhaven et al. "Intersection Modifications Using Mini-/Modular Roundabout Methods." 8 December 2021, https://www.youtube.com/watch?v=rMQmy4XavQc)

7.0 ALTERNATIVES ADVANCED FOR FURTHER EVALUATION

The four alternatives chosen to advance for further evaluation are:

- Alternative A: Do Nothing
- Alternative B: Signal (Standard RT Lane for NB VT 116; Advance Warning)
- Alternative C: Signal (Single Lane Approaches for VT 116; Advance Warning)
- Alternative D: Roundabout

Each alternative is described below.

7.1.1 Alternative A: Do Nothing

For the Do Nothing Alternative, displayed in Figure 3, the existing transportation facilities in the project area remain as they exist today. This alternative has no construction costs and has no impacts on right-of-way, resources, or traffic. The Do Nothing Alternative does not address the Purpose and Need.

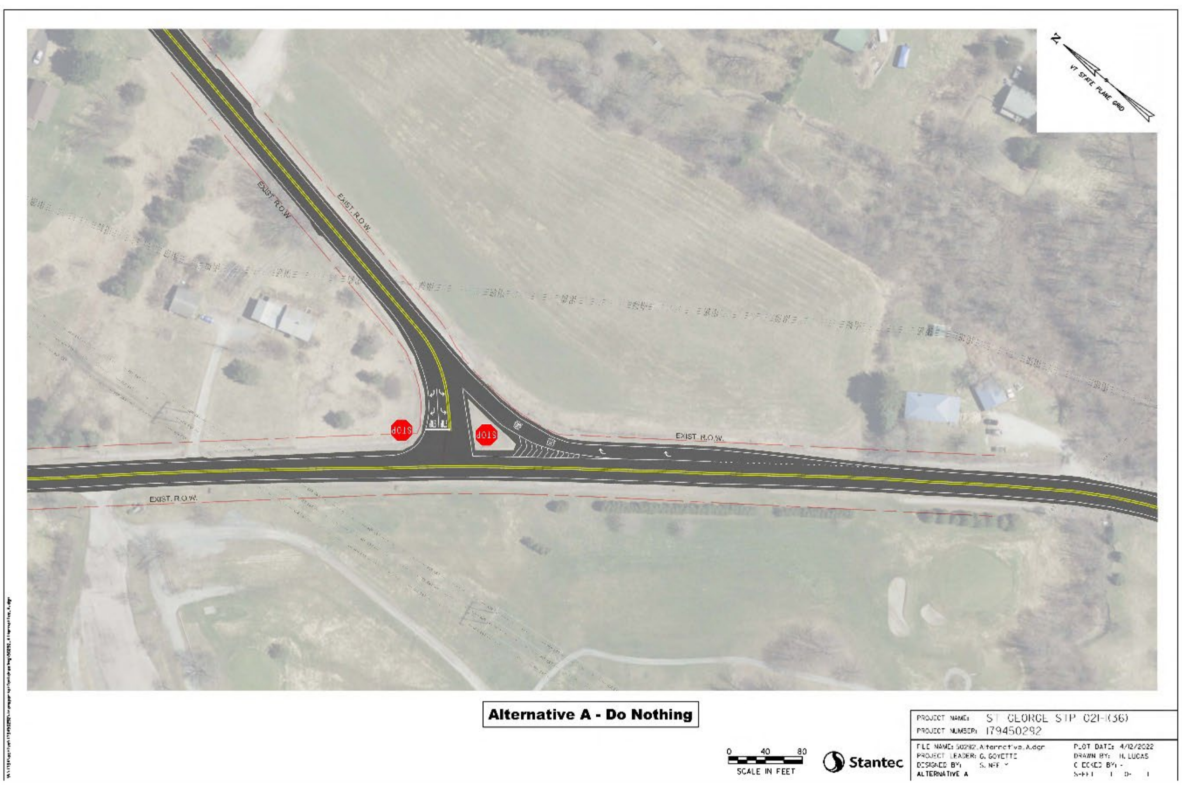


Figure 3: Alternative A – Do Nothing

7.1.2 Alternative B: Signal 1 (Standard RT Lane for NB VT 116; Advance Warning)

This alternative, displayed in Figure 4, proposes signalizing the intersection, modifying intersection geometry by removing the slip lane, and adding advanced warning to help educate motorists about the new signal installation. Some of the area where the island and slip lane currently exist could be used for stormwater treatment. The existing channelized right turn slip lane for northbound motorists on VT 116 turning right onto VT 2A would be removed, replacing it with a standard right turn lane. This would force motorists turning right onto VT 2A to reduce their speed to make the turn.

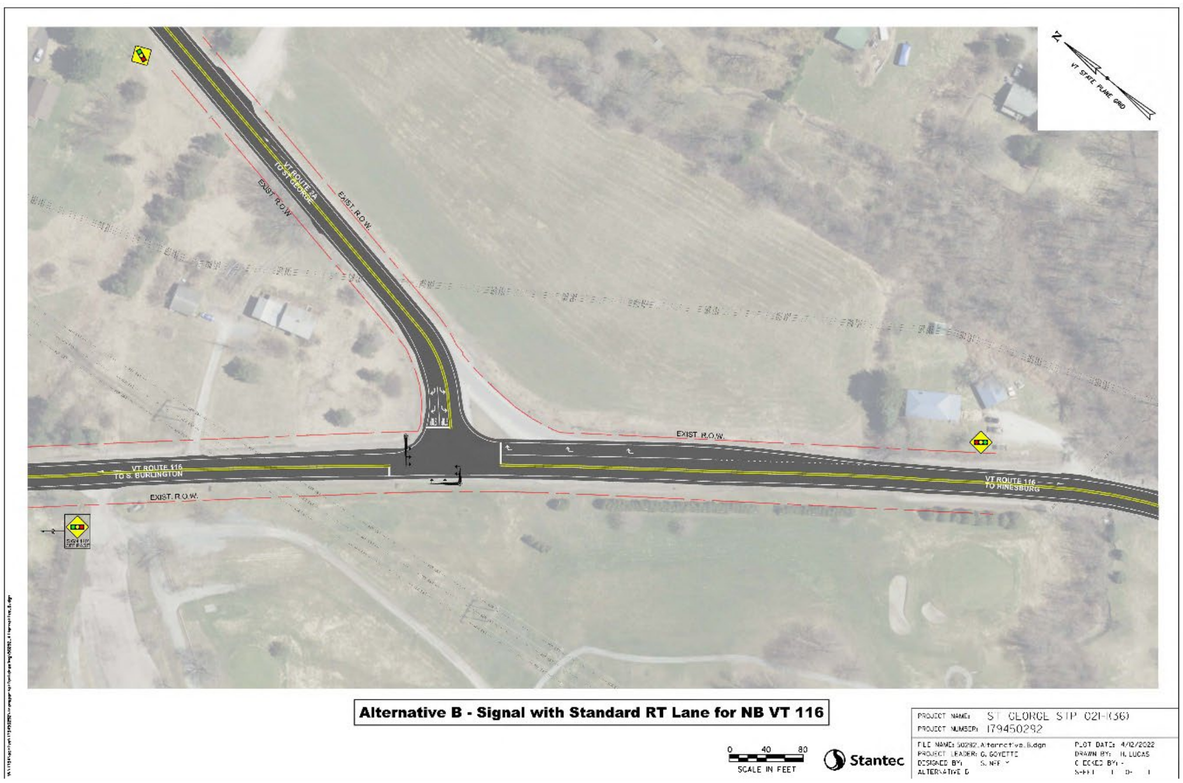


Figure 4: Alternative B – Signal 1 with Standard RT Lane for NB VT 116

7.1.3 Alternative C: Signal 2 (Single Lane Approaches for VT 116; Advance Warning)

This alternative, displayed in Figure 5, also proposes signalizing the intersection, modifying intersection geometry by removing the slip lane, and adding advanced warning to help educate motorists about the new signal installation. Some of the area where the island and slip lane currently exist could be used for stormwater treatment. The existing channelized right turn slip lane for northbound motorists on VT 116 turning right onto VT 2A would be removed, resulting in single lane approaches for VT 116. This would force motorists turning right onto VT 2A to reduce their speed even further to make the turn.

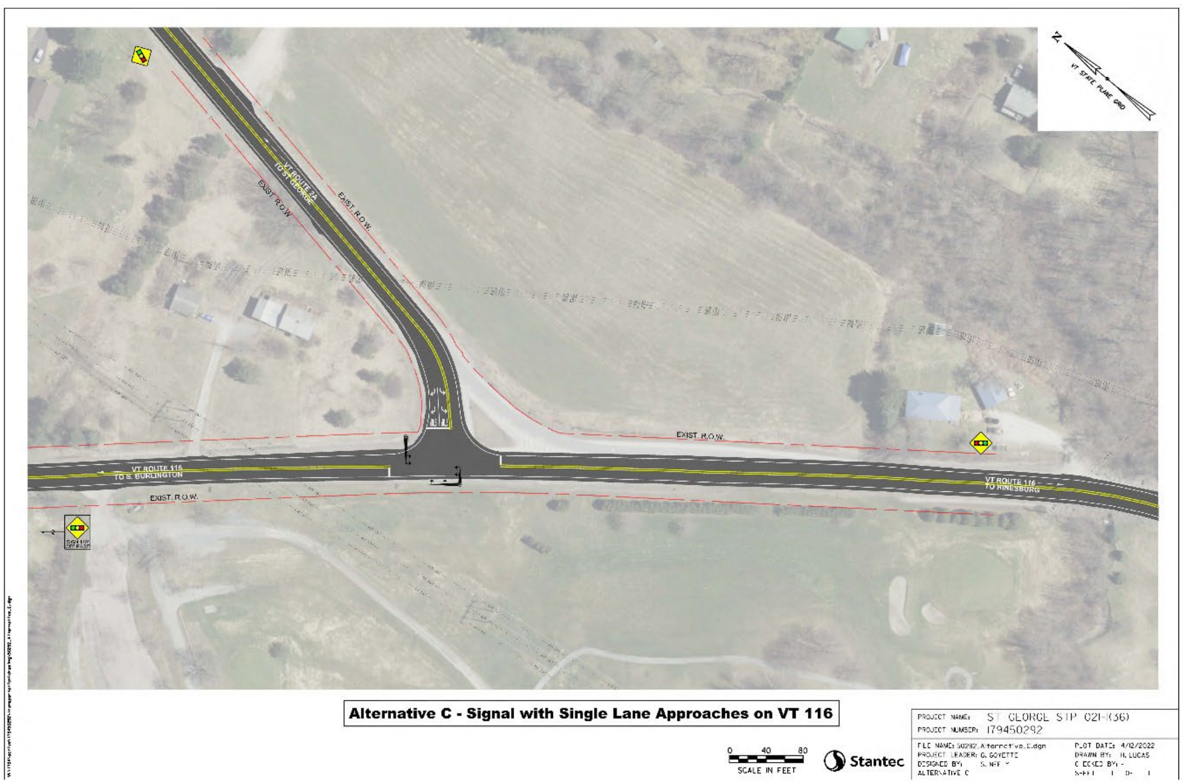


Figure 4: Alternative C – Signal 2 with Single Lane Approaches on VT 116

7.1.4 Alternative D: Roundabout

This alternative, displayed in Figure 6, proposes converting the intersection to a modern single lane roundabout. Full size modern roundabouts are better suited for isolated locations outside of urban areas, speeds greater than 25 mph, and higher volumes of trucks.

In the 2001-2002 Vermont legislative session, Act 141, Section 37 was passed. This provided support for roundabouts by indicating the following, "The general assembly finds that the installation of roundabouts at dangerous intersections in the state has been cost-efficient and has enhanced the safe operation of vehicles at these locations. The Agency of Transportation is directed to carefully examine and pursue the opportunities for construction of roundabouts at intersections determined to pose safety hazards for motorists."

Section 4B.04 of the MUTCD, "Alternatives to Traffic Control Signals", provides the following guidance:

Since vehicular delay and the frequency of some types of crashes are sometimes greater under traffic signal control than under STOP sign control, consideration should be given to providing alternatives to traffic control signals even if one or more of the signal warrants has been satisfied.

One of the alternatives to signalization, provided by the MUTCD to consider, is installing a roundabout.

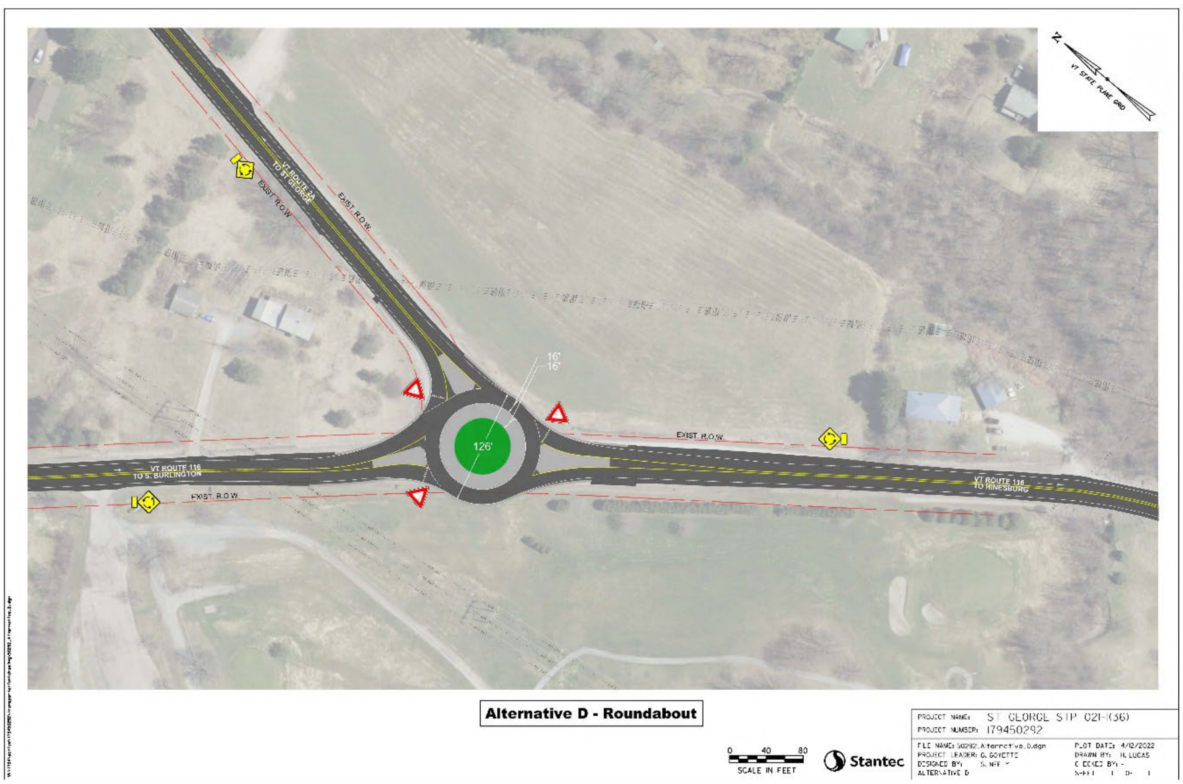


Figure 5: Alternative D – Roundabout

7.2 COMPARISON OF ALTERNATIVES

7.2.1 Alternative Impacts

7.2.1.1 Safety Impacts

Safety for the travelling public is improved in both signal alternatives and the roundabout alternative over the Do Nothing alternative. Sight distance will be improved for both signal alternatives and the roundabout alternative. Vehicle speeds will be improved during the red phases of both signal alternatives, but maybe worse during the green and yellow phases. Vehicle speeds will be improved for all approaches of the roundabout alternative. Crash reduction is expected in the long term for both signal alternatives, with an estimated crash reduction [crash modification factor (CMF)] of 44%. In the short term however, adding a signal where none previously existed, generally results in increased crashes, especially rear ends, while the travelling public gets used to the new signal placement. Advanced warning signs to advise motorists of the signal location will be needed. Crash reduction is expected to be greatest for the roundabout alternative, with an estimated crash reduction (CMF) of 71%.

7.2.1.2 Traffic Calming Impacts

Traffic signals do not calm traffic. Motorists often speed up to avoid a red light.

Modern roundabouts do calm traffic by slowing all vehicles down and maintaining a consistent, slow speed through the intersection.

MassDOT's Guidelines for the Planning and Design of Roundabouts (2020) identified intersections where traffic calming is a desired outcome of the project as sites where roundabouts are often advantageous.

7.2.1.3 Traffic Operations Impacts

Roadway and traffic conditions in the study area were projected to a future construction year of 2025 and design year of 2045. Traffic volumes collected by VTrans in 2015 were increased by six percent and 18 percent, respectively. These growth rates were obtained from the VTrans Continuous Traffic Counter Report (*The Red Book*) Based on 2015 Traffic Data which compiles and analyzes traffic volume data collected by VTrans.

The traffic operations analysis conducted for existing traffic conditions were repeated for future conditions based on the traffic growth assumptions referenced above. As shown in Table 7 below, new traffic growth will increase utilization (V/C) during both the AM and PM peak hours for the intersection. New traffic growth will result in the study intersection being over capacity (V/C >1) under the Do Nothing scenario.

Table 7 compares signalization with a standard right turn lane for the northbound VT 116 approach, against signalization with single lane approaches on VT 116. Results indicate that while signalization with single lane approaches on VT 116 will have more overall delay than with a standard right turn lane, the amount of delay is acceptable and overall LOS B will be maintained through the design year of 2045.

Table 7 also compares signalization with a roundabout. Results of the roundabout capacity analysis suggest acceptable levels of delay and LOS B maintained through the design year of 2045, with less average delay in the PM peak hour, compared with both signal alternatives.

Table 7: Existing and Future Intersection Capacity Analysis Results

		AM Peak Hour	PM Peak Hour
Existing (2021)			
*Stop-controlled Left Turn	LOS[1]	C	F
	Delay[2]	20.7	138.4
	Max V/C[3]	0.39 (WBL)	1.15 (WBL)
Future (2025) No Build			
*Stop-controlled Left Turn	LOS[1]	C	F
	Delay[2]	21.4	157.9
	Max V/C[3]	0.40 (WBL)	1.21 (WBL)
Future (2045) No Build			
*Stop-controlled Left Turn	LOS[1]	D	F
	Delay[2]	26.2	283.1
	Max V/C[3]	0.49 (WBL)	1.51 (WBL)
Future (2045) Signal 1 with Standard RT Lane			
	LOS[1]	A	B
	Delay[2]	8.9	16.0
	Max V/C[3]	0.73 (WBL)	0.85 (WBL)
Future (2045) Signal 2 with Single Lane Approaches on VT 116			
	LOS[1]	B	B
	Delay[2]	14.1	16.5
	Max V/C[4]	0.78 (WBL)	0.85 (WBL)
Future (2045) Single Lane Roundabout			
	LOS[1]	B	B
	Delay[2]	11.9	12.9
	Max V/C[3]	0.73 (NB)	0.78 (SB)

[1] LOS= Level of Service
[2] Delay = Average delay expressed in seconds per vehicle
[3] Max V/C = Maximum lane group Volume-to-Capacity ratio using the HCM method
[4] Overall V/C = Volume-to-capacity ratio for overall intersection

Table 8 displays capacity analysis results for No Build (Do Nothing) scenarios, Table 9 displays capacity analysis results for both signal alternatives, and Table 10 displays capacity analysis results for the roundabout alternative. When summing estimated delay for all approaches, estimated total delay for the intersection is substantially lower for the roundabout compared to either signal alternative. When looking at all approaches, estimated LOS values are higher for the roundabout compared to either signal alternative. When looking at all approaches, estimated V/C for the intersection is substantially lower for the roundabout compared to either signal alternative. This is especially true for the westbound approach, which shows the V/C for the westbound approach for the roundabout alternative as just less than half of the V/C for the westbound approach for either signal alternative. Overall, estimated queue lengths for the 95th percentile are substantially lower for the roundabout compared to either signal alternative.

Table 8 – No Build Weekday Peak Hour Intersection Capacity Analysis Results – Stop-Controlled

Approach	Direction/ turning movement	AM Peak					PM Peak				
		Delay[1]	LOS[2]	v/c[3]	Queue[4]		Delay[1]	LOS[2]	v/c[3]	Queue[4]	
					50th	95th				50th	95th
Existing (2021)											
VT 116	NB T	0	-	-	-	0	0	-	-	-	0
VT 116	NB R	0	-	-	-	0	0	-	-	-	0
VT 116	SB	1.1	A	0.02	-	0	0.6	A	0.03	-	3
VT 2A	WB	19.2	C	0.39	-	45	126.1	F	1.15	-	363
OVERALL		**3.0**	**-**	**-**			**34.5**	**-**	**-**		
Future (2025) No Build											
VT 116	NB T	0	-	-	-	0	0	-	-	-	0
VT 116	NB R	0	-	-	-	0	0	-	-	-	0
VT 116	SB	8.7	A	0.02	-	3	0.6	A	0.04	-	3
VT 2A	WB	19.8	C	0.40	-	48	143.7	F	1.21	-	393
OVERALL		**3.1**	**-**	**-**			**39.3**	**-**	**-**		
Future (2045) No Build											
VT 116	NB T	0	-	-	-	0	0	-	-	-	0
	NB R	0	-	-	-	0	0	-	-	-	0
VT 116	SB	8.9	A	0.02	-	3	7.7	A	0.04	-	3
VT 2A	WB	26.2	D	0.49	-	651	283.1	F	1.51	-	650
OVERALL		**3.7**	**-**	**-**			**70**	**-**	**-**		

Table 9 – Weekday Peak Hour Intersection Capacity Analysis Results – Signals

Approach	Direction/ turning movement	AM Peak					PM Peak				
		Delay[1]	LOS[2]	v/c[3]	Queue[4]		Delay[1]	LOS[2]	v/c[3]	Queue[4]	
					50th	95th				50th	95th
Future (2045) Signal 1 - Standard RT Lane											
VT 116	NB T	5.3	A	0.56	115	223	7.3	A	0.22	41	76
VT 116	NB R	4.6	A	0.40	0	33	7.5	A	0.23	0	26
VT 116	SB	3.8	A	0.15	19	51	13.6	B	0.69	207	266
VT 2A	WB L	20.2	C	0.73	45	90	29.6	C	0.85	123	185
	WB R	18.7	B	0.17	0	14	16.3	B	0.10	0	16
OVERALL		**8.9**	**A**	-			**16.0**	**B**			
Future (2045) Signal 2 - Single Lane Approaches on VT 116											
VT 116	NB T/R	11.4	B	0.77	264	#490	7.9	A	0.44	62	121
VT 116	SB	5.0	A	0.18	22	52	9.8	B	0.69	210	270
VT 2A	WB L	36.2	D	0.78	69	127	20.0	C	0.85	123	185
	WB R	28.3	C	0.18	0	18	16.2	B	0.10	0	16
OVERALL		**14.1**	**B**	-			**16.5**	**B**	-		

Table 10 – Weekday Peak Hour Intersection Capacity Analysis Results – Roundabout

Approach	Direction/ turning movement	AM Peak					PM Peak				
		Delay[1]	LOS[2]	v/c[3]	Queue[4]		Delay[1]	LOS[2]	v/c[3]	Queue[4]	
					50th	95th				50th	95th
Future (2045) Single Lane Roundabout											
VT 116	NB	13.5	B	0.73	-	175	5.8	A	0.32	-	25
VT 116	SB	4.7	A	0.14	-	0	20.2	C	0.78	-	200
VT 2A	WB	9.5	A	0.30	-	1	7.3	A	0.39	-	50
OVERALL		**11.9**	**B**	**-**			**12.9**	**B**	**-**		

1. Delay in seconds per vehicle 2. Level of Service according to HCM 3. Volume to Capacity Ratio 4. Queue in feet per lane: 50th percentile and 95th percentile (25 feet per vehicle)
#. 95th percentile volume exceeds capacity, queue may be longer

7.2.1.4 Right-of-Way (ROW) Impacts

Impacts to ROW are not anticipated for either signal alternative. Minor impacts to ROW are anticipated for the roundabout alternative, with permanent impacts expected to be approximately 0.05 acre.

7.2.1.5 Utility Impacts

Aerial utilities in the project area are not expected to be impacted by any of the alternatives. Underground utilities in the project area would require coordination with the individual utility companies during design and construction but are not expected to be significantly impacted by any of the alternatives.

7.2.1.6 Maintenance Impacts

Both signal alternatives would add more State-owned signal equipment to the State transportation system. This would require ongoing maintenance for the new signal equipment, including future upgrades, equipment replacement costs, and staff labor. In addition to costs for maintaining/replacing equipment and staff labor, annual electric costs will be incurred for the life of the signal. A signal would likely require full replacement within 20 years.

The roundabout alternative would require the Maintenance District to adapt snowplow operations to adequately maintain the roundabout during the winter. This may include allocating a new snowplow that is sized for the roundabout. As the State builds more roundabouts, as supported by Act 141, Section 37, this demand to modify snowplow operations for roundabouts will increase. Rejecting roundabout alternatives due to a lack of sufficient plowing equipment in districts where they are proposed is not sustainable in the long term.

The roundabout alternative would also require maintenance of curbing.

Maintenance needed whether a signal or a roundabout is constructed includes pavement and drainage.

7.2.1.7 Stormwater Impacts

It is not yet known if an Operational Stormwater permit will be needed. If it is not, and a Construction Stormwater Permit is needed, the TS4 “Gap” procedure and related post construction treatment measures will be required. No existing stormwater permits are in place near the project site. No formal stormwater treatment is currently within the ROW.

Both signal alternatives and the roundabout alternative will result in improved stormwater by replacing the two existing 15” CMP culverts in poor condition that are connected to a drop inlet in the existing central island of the intersection.

Drainage in the project area also includes grass and stone lined swales along with sheet flow into the golf course. Drainage from the project area goes south to the unnamed tributary of the LaPlatte River.

Soils in the project area are documented as hydrologic soil group C/D, which are not ideal for infiltration. Sheet flow through vegetation is more suitable for the project area.

7.2.1.8 Environmental Resource Impacts

Based on the natural resource identification conducted by VTrans, there are no known impacts to streams, wetlands, wildlife habitat, or rare, threatened and endangered species for the alternatives.

7.2.1.9 Cultural Resource Impacts

Historic and archeological resources were evaluated by VTrans. Summaries of the findings are presented in Appendix 5. VTrans Cultural Resources staff used a large preliminary Area of Potential Effect (APE) to include all relevant cultural resources that could be impacted. After conceptual design is completed for the project, Cultural Resources staff will formalize the APE per Section 106 and 22 VSA § 14.

The Lockwood-Peet House and outbuilding at 7601 Route 116 are both 4(f) and historic. None of the alternatives chosen to advance for further evaluation would impact the house or outbuilding.

Most of the project area can be considered archaeologically sensitive, except for the immediate areas adjacent to the roadway, including ditches and underground utilities. Further study for areas to be impacted by the preferred alternative is recommended by the VTrans Archaeology Officer.

7.2.2 Project Costs

The following table is a summary of the project costs for each alternative. ROW costs are not included.

Table 11: Summary of Project Costs

Item	Alternative A Do Nothing	Alternative B Signal 1: Standard RT Turn Lane NB	Alternative C Signal 2: Single Lane Approaches	Alternative D Roundabout
Construction Costs	**$0**	$1,530,000	$1,400,000	$1,790,000
Design Engineering	**$0**	$306,000	$280,000	$358,000
Municipal Project Management	**$0**	$306,000	$280,000	$358,000
Construction Engineering	**$0**	$245,000	$224,000	$287,000
Total Project Costs	**$0**	$2,387,000	$2,184,000	$2,793,000

7.2.3 Evaluation Matrix

The following table provides an evaluation matrix summarizing the above information pertaining to safety, traffic operations, right-of-way, environmental, cultural resources, utilities, and project costs. According to the RSAR, the roundabout would have a greater reduction in crashes than the signal options. The roundabout would better mitigate vehicle speeds than the signal options. The roundabout would improve capacity as well as or better than the signal options. The roundabout would require minor ROW acquisition, while the signal options would not. The roundabout would also have a greater construction cost than the signal options.

Table 12: Evaluation Matrix

	Do Nothing	Signal 1 Standard RT Lane for NB VT 116	Signal 2 Single Lane Approaches on VT 116	Roundabout
Purpose& Need				
Reduce Crash Factors	No Change	≥44% Reduction* (No slip lane)	≥44% Reduction* (No slip lane)	71% Reduction
Mitigate Vehicle Speeds	No Change	Improved for red phase; Green/yellow maybe worse	Improved for red phase; Green/yellow maybe worse	Better
Improve Sight Distance	No Change	Better	Better	Better
Improve Capacity	No Change	VT 2A Better; VT 116 Worse	VT 2A Better; VT 116 Worse	Better
Resource Impacts				
Wetlands & Streams	No Change	Better	Better	Better
RTE	None	None	None	None
Wildlife Habitat	No Impact	No Impact	No Impact	No Impact
Hazardous Material	N/A	N/A	N/A	N/A
Ag. Soils	N/A	N/A	N/A	N/A
Invasive Species	N/A	N/A	N/A	N/A
Historical	No Change	No Change	No Change	No Change
Archeological	No Change	Possible**	Possible**	Possible**
Maintenance	No Change	New State Signal Equipment	New State Signal Equipment	New State Plowing Equipment
Utilities	No Change	Requires Coordination	Requires Coordination	Requires Coordination
Drainage	No Change	Improved	Improved	Improved
ROW	None	None	None	Minor
Construction Costs	None	$1.6 M	$1.4 M	$1.8 M

*NOTE: Installing traffic signals where none existed previously often has a crash modification factor (CMF) of 44%, although with a short-term impact of increasing crashes, especially rear ends, while the traveling public gets used to new signal placement.
**NOTE: Further consultation with VTrans Archeology officer required.

8.0 STAKEHOLDER INPUT AND RECOMMENDATIONS

The project team reached out to the Town of St. George to inquire if they would like to host a Local Concerns Meeting, but no response was obtained. On October 28, 2021, the project team held a Local Concerns Meeting at the town offices in Hinesburg. The meeting was a hybrid format and included the ability for participants to join the meeting online. One attendee joined in-person and provided input. One attendee joined online but did not provide any input. In addition, three community members provided input by email. Input received is listed below.

Attendee Input

- Generally agrees with the information Stantec has developed to date in regards to the issues identified at the intersection.
- He knows of several crashes that have occurred in the past.
- Mowing of the triangle by others is crucial to sight distance.
- While he does not utilize the intersection very much (he uses Brownell Road to bypass it to get to his job in Williston), he knows bicyclists are regulars.
- There are potential development opportunities at Rocky Ridge Golf Course.
- The selected alternative should have winter plowing and other maintenance considerations.

Email Input

- Problems arise when:
    - Motorists do not follow the speed limit
    - Motorists pull out in front of other vehicles with insufficient space
- From VT 2A, the sight line to the north is not great. It can be difficult to gauge speed of SB vehicles.
- For left turns from SB VT 116, problems arise as motorists attempt to pass on the right.
- Nearby residents must be challenged to pull in or out during peak periods.
    - They can see how better or safer access for them would be an improvement.
- If a traffic light is installed, consider moving the golf course entrance to the south to make it a four-way intersection.
- Occasional police with radar presence could be helpful.

- One participant expressed they feel the intersection is sufficient ‘as-is’ (they vote Do Nothing).

- One nearby resident expressed they think a solution is removing the NB right-turn lane to eliminate the blind spot and that NB right-turners should not have to yield.

On September 27, 2021, the project team held an Alternatives Presentation at the CCRPC offices in Winooski. The meeting was a hybrid format and included the ability for participants to join the meeting online. Four attendees joined online and provided input, listed below.

- Attendee
    - Q: What would happen if the traffic volumes increase to near capacity? *A: The analysis suggests that the roundabout will have additional capacity to address volume increases in the future. If traffic volumes increase at a higher rate than projected in the analysis, then capacity could be analyzed, and additional lanes to the approaches and the circulating roadway could be added if necessary.*
- Attendee

    - Lives in St George and can see the intersection from his house. He grew up in Maine and has seen many accidents and fatalities at rotaries. He has concerns that people don't know how to drive through them. He was disappointed that there wasn't much public interest in the project. He doesn't recall seeing it on the St George Front Porch Forum page. The team reached out to St. George Selectboard with no response.
- Attendee
    - Q: Would the roundabout accommodate bicycles and pedestrians? *A: Bicycle accommodations would be considered during design. There is no pedestrian activity in the area or existing pedestrian facilities.*
- Joel Colf - lives in St. George and is an active member of the Selectboard.
    - Q: Would the roundabout encroach upon private land? *A: The roundabout would require additional ROW to construct.*
    - Q: Would the roundabout increase the financial obligation to the Town? *A: No. The project would be 100% federally funded. The State would maintain the roundabout since it is the intersection of two state highways.*
    - Q: Would the existing culverts be replaced with the roundabout? *A: Yes, they likely would be replaced or reconstructed to accommodate the new drainage patterns for the*
- Mike LaCroix
    - Q: Would Joel be willing to be the selectboard contact for VTrans? *A: Yes.*
- Eleni Churchill
    - Q: Were ROW costs considered in the cost estimates? *A: No.*
    - Q: Are archeological resources a showstopper for the project? *A: No. The study area has been identified as an archeologically sensitive area by VTrans. Further investigation will be completed once a preferred design concept is selected and advanced into design.*
- Attendee
    - Q: Can a copy of the presentations from October 2021 and September 2022 be shared? *A: The draft report and presentations will be shared with Joel, who can distribute and include links on the Town's website.*

9.0 PREFERRED ALTERNATIVE

Based on evaluation by the project team, including VTrans and the CCRPC, with input from the public, the project team recommends Alternative D, a full-size single lane modern roundabout, as the best alternative to meet the project Purpose and Need. Alternative D is preferred over both signal alternatives due to greater crash reduction, better speed mitigation, and better capacity. Another advantage is that it reduces the amount of equipment being added to the State’s responsibility for signal maintenance.

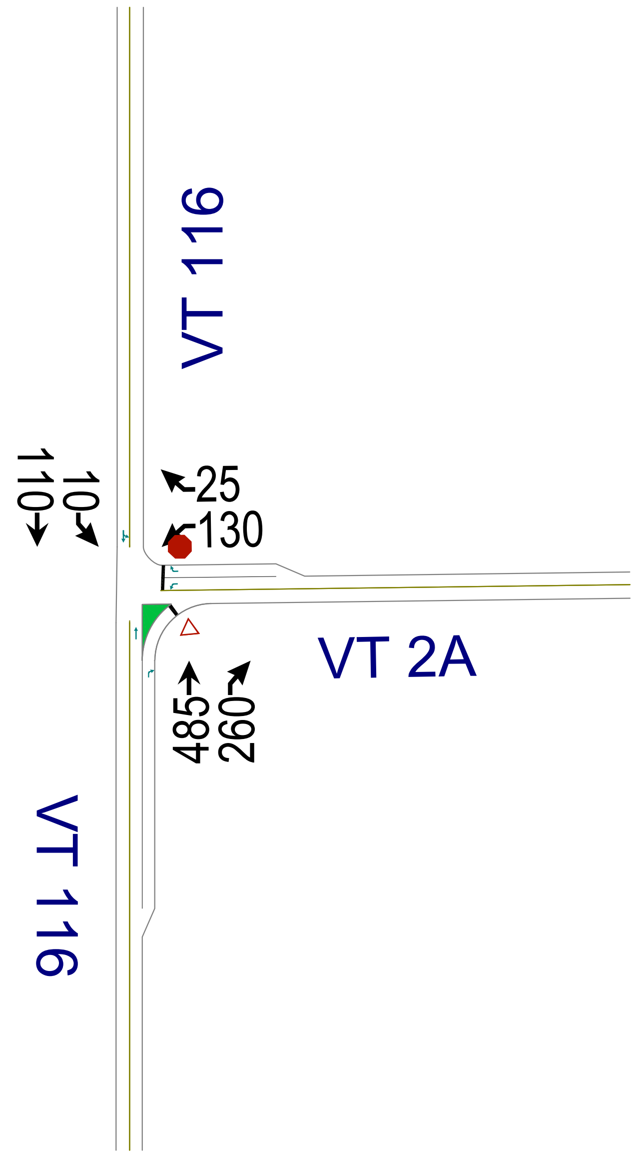
The Town of St. George Selectboard reviewed this study and endorses Alternative D, a full-size single lane modern roundabout. From the Selectboard Minutes for February 2, 2023:

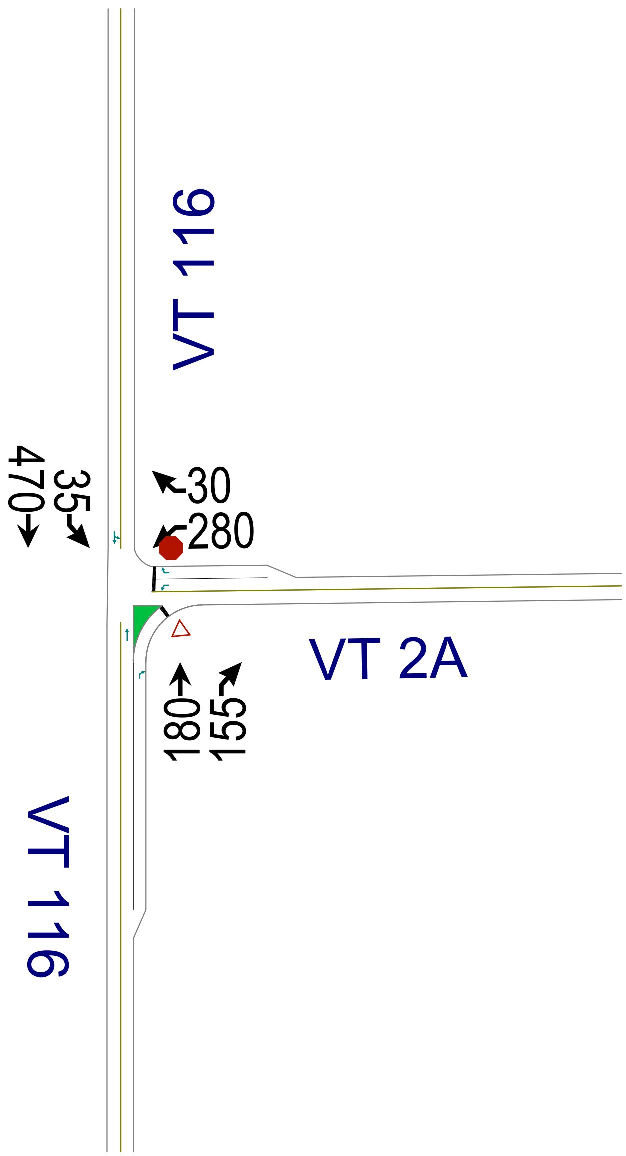
“The Selectboard acknowledged and approved the findings of the VTrans report, and subsequent public presentation held on December 1, 2022, outlining the plan to construct a roundabout at the intersection of VT Route 116 and VT Route 2A. The approval and overwhelming support for the project has been echoed by Champlain Valley School District school bus drivers, motorcyclists, local Fire & Rescue first responders, and Ed Coleman, Pro and Manager of Rocky Ridge Golf Course.”

VTrans will subsequently advance the preferred alternative into detailed design and construction.

APPENDIX 1

EXISTING AM & PM PEAK HOUR
TURNING MOVEMENT COUNTS


VT 116
25
130
10
110
VT 2A
485
260
VT 116


VT 116
35
470
30
280
VT 2A
180
155
VT 116

APPENDIX 2

TRAFFIC CAPACITY ANALYSIS WORKSHEETS

Lane Group	WBL	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	143	32	577	283	136
Sign Control	Stop		Free		Free

Intersection Summary	
Control Type: Unsignalized	
Intersection Capacity Utilization 39.4%	ICU Level of Service A
Analysis Period (min) 15	

Intersection	
Int Delay, s/veh	3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	130	25	485	260	10	110
Future Vol, veh/h	130	25	485	260	10	110
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	Yield	-	None
Storage Length	0	100	-	250	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	91	79	84	92	56	93
Heavy Vehicles, %	10	5	2	4	0	10
Mvmt Flow	143	32	577	283	18	118

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	731	577	0	0	577	0
Stage 1	577	-	-	-	-	-
Stage 2	154	-	-	-	-	-
Critical Hdwy	6.5	6.25	-	-	4.1	-
Critical Hdwy Stg 1	5.5	-	-	-	-	-
Critical Hdwy Stg 2	5.5	-	-	-	-	-
Follow-up Hdwy	3.59	3.345	-	-	2.2	-
Pot Cap-1 Maneuver	377	511	-	-	1006	-
Stage 1	546	-	-	-	-	-
Stage 2	855	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	370	511	-	-	1006	-
Mov Cap-2 Maneuver	370	-	-	-	-	-
Stage 1	546	-	-	-	-	-
Stage 2	839	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	19.2	0	1.1
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	370	511	1006	-
HCM Lane V/C Ratio	-	-	0.386	0.062	0.018	-
HCM Control Delay (s)	-	-	20.7	12.5	8.6	0
HCM Lane LOS	-	-	C	B	A	A
HCM 95th %tile Q(veh)	-	-	1.8	0.2	0.1	-

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	280	30	180	155	35	470
Future Volume (vph)	280	30	180	155	35	470
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	11	11	11	11
Storage Length (ft)	0	100		250	0	
Storage Lanes	1	1		1	0	
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt		0.850		0.850		
Flt Protected	0.950					0.996
Satd. Flow (prot)	1728	1561	1801	1516	0	1829
Flt Permitted	0.950					0.996
Satd. Flow (perm)	1728	1561	1801	1516	0	1829
Link Speed (mph)	30		30			30
Link Distance (ft)	438		495			505
Travel Time (s)	10.0		11.3			11.5
Confl. Peds. (#/hr)	1	1				
Peak Hour Factor	0.82	0.83	0.93	0.91	0.73	0.78
Heavy Vehicles (%)	1%	0%	2%	3%	0%	0%
Adj. Flow (vph)	341	36	194	170	48	603
Shared Lane Traffic (%)						
Lane Group Flow (vph)	341	36	194	170	0	651
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(ft)	11		0			0
Link Offset(ft)	0		0			0
Crosswalk Width(ft)	16		16			16
Two way Left Turn Lane						
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (mph)	15	9		9	15	
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 61.7% ICU Level of Service B

Analysis Period (min) 15

Intersection	
Int Delay, s/veh	34.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	280	30	180	155	35	470
Future Vol, veh/h	280	30	180	155	35	470
Conflicting Peds, #/hr	1	1	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	Yield	-	None
Storage Length	0	100	-	250	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	82	83	93	91	73	78
Heavy Vehicles, %	1	0	2	3	0	0
Mvmt Flow	341	36	194	170	48	603

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	894	195	0	0	194	0
Stage 1	194	-	-	-	-	-
Stage 2	700	-	-	-	-	-
Critical Hdwy	6.41	6.2	-	-	4.1	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.3	-	-	2.2	-
Pot Cap-1 Maneuver	~ 313	851	-	-	1391	-
Stage 1	841	-	-	-	-	-
Stage 2	494	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 296	850	-	-	1391	-
Mov Cap-2 Maneuver	~ 296	-	-	-	-	-
Stage 1	841	-	-	-	-	-
Stage 2	468	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	126.1	0	0.6
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	296	850	1391	-
HCM Lane V/C Ratio	-	-	1.154	0.043	0.034	-
HCM Control Delay (s)	-	-	138.4	9.4	7.7	0
HCM Lane LOS	-	-	F	A	A	A
HCM 95th %tile Q(veh)	-	-	14.5	0.1	0.1	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	3.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	130	25	485	260	10	110
Future Vol, veh/h	130	25	485	260	10	110
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	Yield	-	None
Storage Length	0	100	-	250	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	91	79	84	92	56	93
Heavy Vehicles, %	10	5	2	4	0	10
Mvmt Flow	146	32	589	288	18	121

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	746	589	0	0	589	0
Stage 1	589	-	-	-	-	-
Stage 2	157	-	-	-	-	-
Critical Hdwy	6.5	6.25	-	-	4.1	-
Critical Hdwy Stg 1	5.5	-	-	-	-	-
Critical Hdwy Stg 2	5.5	-	-	-	-	-
Follow-up Hdwy	3.59	3.345	-	-	2.2	-
Pot Cap-1 Maneuver	370	503	-	-	996	-
Stage 1	539	-	-	-	-	-
Stage 2	852	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	363	503	-	-	996	-
Mov Cap-2 Maneuver	363	-	-	-	-	-
Stage 1	539	-	-	-	-	-
Stage 2	836	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	19.8	0	1.1
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	363	503	996	-
HCM Lane V/C Ratio	-	-	0.401	0.064	0.018	-
HCM Control Delay (s)	-	-	21.4	12.6	8.7	0
HCM Lane LOS	-	-	C	B	A	A
HCM 95th %tile Q(veh)	-	-	1.9	0.2	0.1	-

Intersection						
Int Delay, s/veh	39.3					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	280	30	180	155	35	470
Future Vol, veh/h	280	30	180	155	35	470
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	Yield	-	None
Storage Length	0	100	-	250	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	82	83	93	91	73	78
Heavy Vehicles, %	1	0	2	3	0	0
Mvmt Flow	348	37	197	174	49	615

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	910	197	0	0	197	0
Stage 1	197	-	-	-	-	-
Stage 2	713	-	-	-	-	-
Critical Hdwy	6.41	6.2	-	-	4.1	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.3	-	-	2.2	-
Pot Cap-1 Maneuver	~ 306	849	-	-	1388	-
Stage 1	839	-	-	-	-	-
Stage 2	488	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 289	849	-	-	1388	-
Mov Cap-2 Maneuver	~ 289	-	-	-	-	-
Stage 1	839	-	-	-	-	-
Stage 2	462	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	143.7	0	0.6
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	289	849	1388	-
HCM Lane V/C Ratio	-	-	1.205	0.043	0.035	-
HCM Control Delay (s)	-	-	157.9	9.4	7.7	0
HCM Lane LOS	-	-	F	A	A	A
HCM 95th %tile Q(veh)	-	-	15.7	0.1	0.1	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	3.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	130	25	485	260	10	110
Future Vol, veh/h	130	25	485	260	10	110
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	Yield	-	None
Storage Length	0	100	-	250	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	91	79	84	92	56	93
Heavy Vehicles, %	10	5	2	4	0	10
Mvmt Flow	160	35	647	317	20	132

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	819	647	0	0	647	0
Stage 1	647	-	-	-	-	-
Stage 2	172	-	-	-	-	-
Critical Hdwy	6.5	6.25	-	-	4.1	-
Critical Hdwy Stg 1	5.5	-	-	-	-	-
Critical Hdwy Stg 2	5.5	-	-	-	-	-
Follow-up Hdwy	3.59	3.345	-	-	2.2	-
Pot Cap-1 Maneuver	334	466	-	-	948	-
Stage 1	506	-	-	-	-	-
Stage 2	839	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	326	466	-	-	948	-
Mov Cap-2 Maneuver	326	-	-	-	-	-
Stage 1	506	-	-	-	-	-
Stage 2	820	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	23.9	0	1.2
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	326	466	948	-
HCM Lane V/C Ratio	-	-	0.491	0.076	0.021	-
HCM Control Delay (s)	-	-	26.2	13.4	8.9	0
HCM Lane LOS	-	-	D	B	A	A
HCM 95th %tile Q(veh)	-	-	2.6	0.2	0.1	-

Approach	
Approach Direction	NB
Median Present?	No
Approach Delay(s)	25.0
Level of Service	D

Crosswalk	
Length (ft)	31
Lanes Crossed	2
Veh Vol Crossed	595
Ped Vol Crossed	0
Yield Rate(%)	0
Ped Platooning	No
Critical Headway (s)	11.86
Prob of Delayed X-ing	0.86
Prob of Blocked Lane	0.62
Delay for adq Gap	29.14
Avg Ped Delay (s)	25.03

Approach	
Approach Direction	SB
Median Present?	No
Approach Delay(s)	25.0
Level of Service	D

Crosswalk	
Length (ft)	31
Lanes Crossed	2
Veh Vol Crossed	595
Ped Vol Crossed	0
Yield Rate(%)	0
Ped Platooning	No
Critical Headway (s)	11.86
Prob of Delayed X-ing	0.86
Prob of Blocked Lane	0.62
Delay for adq Gap	29.14
Avg Ped Delay (s)	25.03

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	280	30	180	155	35	470
Future Volume (vph)	280	30	180	155	35	470
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	11	11	11	11
Storage Length (ft)	0	100		250	0	
Storage Lanes	1	1		1	0	
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950					0.996
Satd. Flow (prot)	1728	1561	1801	1516	0	1829
Flt Permitted	0.950					0.996
Satd. Flow (perm)	1728	1561	1801	1516	0	1829
Link Speed (mph)	30		30			30
Link Distance (ft)	438		495			505
Travel Time (s)	10.0		11.3			11.5
Peak Hour Factor	0.82	0.83	0.93	0.91	0.73	0.78
Growth Factor	112%	112%	112%	112%	112%	112%
Heavy Vehicles (%)	1%	0%	2%	3%	0%	0%
Adj. Flow (vph)	382	40	217	191	54	675
Shared Lane Traffic (%)						
Lane Group Flow (vph)	382	40	217	191	0	729
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(ft)	11		0			0
Link Offset(ft)	0		0			0
Crosswalk Width(ft)	16		16			16
Two way Left Turn Lane						
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (mph)	15	9		9	15	
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 67.9% ICU Level of Service C

Analysis Period (min) 15

Intersection	
Int Delay, s/veh	70

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	280	30	180	155	35	470
Future Vol, veh/h	280	30	180	155	35	470
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	Yield	-	None
Storage Length	0	100	-	250	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	82	83	93	91	73	78
Heavy Vehicles, %	1	0	2	3	0	0
Mvmt Flow	382	40	217	191	54	675

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1000	217	0	0	217	0
Stage 1	217	-	-	-	-	-
Stage 2	783	-	-	-	-	-
Critical Hdwy	6.41	6.2	-	-	4.1	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.3	-	-	2.2	-
Pot Cap-1 Maneuver	~ 271	828	-	-	1365	-
Stage 1	822	-	-	-	-	-
Stage 2	452	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 254	828	-	-	1365	-
Mov Cap-2 Maneuver	~ 254	-	-	-	-	-
Stage 1	822	-	-	-	-	-
Stage 2	424	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	256.9	0	0.6
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	254	828	1365	-
HCM Lane V/C Ratio	-	-	1.506	0.049	0.039	-
HCM Control Delay (s)	-	-	283.1	9.6	7.7	0
HCM Lane LOS	-	-	F	A	A	A
HCM 95th %tile Q(veh)	-	-	22.4	0.2	0.1	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Lane Group	WBL	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	160	35	647	390	152
Act Effct Green (s)	10.7	10.7	35.9	35.9	35.9
Actuated g/C Ratio	0.20	0.20	0.66	0.66	0.66
v/c Ratio	0.52	0.11	0.55	0.35	0.15
Control Delay	25.3	7.6	10.1	1.9	6.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	25.3	7.6	10.1	1.9	6.5
LOS	C	A	B	A	A
Approach Delay	22.1		7.0		6.5
Approach LOS	C		A		A
Queue Length 50th (ft)	45	0	115	0	19
Queue Length 95th (ft)	90	14	223	33	51
Internal Link Dist (ft)	358		415		425
Turn Bay Length (ft)		100		250	
Base Capacity (vph)	523	514	1183	1120	1009
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.31	0.07	0.55	0.35	0.15

Intersection Summary	
Cycle Length: 60	
Actuated Cycle Length: 54.7	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.55	
Intersection Signal Delay: 9.1	Intersection LOS: A
Intersection Capacity Utilization 46.7%	ICU Level of Service A
Analysis Period (min) 15	

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	130	25	485	320	10	110
Future Volume (veh/h)	130	25	485	320	10	110
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1752	1826	1870	1841	1900	1752
Adj Flow Rate, veh/h	160	35	647	390	20	132
Peak Hour Factor	0.91	0.79	0.84	0.92	0.56	0.93
Percent Heavy Veh, %	10	5	2	4	0	10
Cap, veh/h	220	204	1160	968	151	858
Arrive On Green	0.13	0.13	0.62	0.62	0.62	0.62
Sat Flow, veh/h	1668	1547	1870	1560	107	1384
Grp Volume(v), veh/h	160	35	647	390	152	0
Grp Sat Flow(s),veh/h/ln	1668	1547	1870	1560	1491	0
Q Serve(g_s), s	4.5	1.0	9.7	6.1	0.0	0.0
Cycle Q Clear(g_c), s	4.5	1.0	9.7	6.1	1.7	0.0
Prop In Lane	1.00	1.00		1.00	0.13	
Lane Grp Cap(c), veh/h	220	204	1160	968	1009	0
V/C Ratio(X)	0.73	0.17	0.56	0.40	0.15	0.00
Avail Cap(c_a), veh/h	621	576	1160	968	1009	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	20.2	18.7	5.3	4.6	3.8	0.0
Incr Delay (d2), s/veh	4.6	0.4	1.9	1.3	0.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.8	0.3	2.8	1.5	0.5	0.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	24.8	19.1	7.3	5.9	4.1	0.0
LnGrp LOS	C	B	A	A	A	A
Approach Vol, veh/h	195		1037			152
Approach Delay, s/veh	23.7		6.8			4.1
Approach LOS	C		A			A

Timer - Assigned Phs	2	6	8
Phs Duration (G+Y+Rc), s	36.0	36.0	12.4
Change Period (Y+Rc), s	6.0	6.0	6.0
Max Green Setting (Gmax), s	30.0	30.0	18.0
Max Q Clear Time (g_c+I1), s	11.7	3.7	6.5
Green Ext Time (p_c), s	5.8	1.0	0.4

Intersection Summary	
HCM 6th Ctrl Delay	8.9
HCM 6th LOS	A

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	130	25	485	320	10	110
Future Volume (veh/h)	130	25	485	320	10	110
Number	3	18	2	12	1	6
Initial Q, veh	0	0	0	0	0	0
Ped-Bike Adj (A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Lanes Open During Work Zone						
Adj Sat Flow, veh/h/ln	1752	1826	1870	1841	1900	1752
Adj Flow Rate, veh/h	160	35	647	390	20	132
Peak Hour Factor	0.91	0.79	0.84	0.92	0.56	0.93
Percent Heavy Veh, %	10	5	2	4	0	10
Opposing Right Turn Influence	Yes				Yes	
Cap, veh/h	220	204	1160	968	151	858
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Prop Arrive On Green	0.13	0.13	0.62	0.62	0.62	0.62
Unsig. Movement Delay						
Ln Grp Delay, s/veh	24.8	19.1	7.3	5.9	4.1	0.0
Ln Grp LOS	C	B	A	A	A	A
Approach Vol, veh/h	195		1037			152
Approach Delay, s/veh	23.7		6.8			4.1
Approach LOS	C		A			A

Timer:	1	2	3	4	5	6	7	8
Assigned Phs		2	8			6		
Case No		7.0	9.0			8.0		
Phs Duration (G+Y+Rc), s		36.0	12.4			36.0		
Change Period (Y+Rc), s		6.0	6.0			6.0		
Max Green (Gmax), s		30.0	18.0			30.0		
Max Allow Headway (MAH), s		4.8	3.9			5.8		
Max Q Clear (g_c+I1), s		11.7	6.5			3.7		
Green Ext Time (g_e), s		5.8	0.4			1.0		
Prob of Phs Call (p_c)		1.00	0.93			1.00		
Prob of Max Out (p_x)		0.00	0.00			0.00		
Left-Turn Movement Data								
Assigned Mvmt		5	3			1		
Mvmt Sat Flow, veh/h		0	1668			107		
Through Movement Data								
Assigned Mvmt		2	8			6		
Mvmt Sat Flow, veh/h		1870	0			1384		
Right-Turn Movement Data								
Assigned Mvmt		12	18			16		
Mvmt Sat Flow, veh/h		1560	1547			0		
Left Lane Group Data								
Assigned Mvmt	0	5	3	0	0	1	0	0
Lane Assignment			L			L+T		

Lanes in Grp	0	0	1	0	0	1	0	0
Grp Vol (v), veh/h	0	0	160	0	0	152	0	0
Grp Sat Flow (s), veh/h/ln	0	0	1668	0	0	1491	0	0
Q Serve Time (g_s), s	0.0	0.0	4.5	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	0.0	4.5	0.0	0.0	1.7	0.0	0.0
Perm LT Sat Flow (s_l), veh/h/ln	0	0	1668	0	0	553	0	0
Shared LT Sat Flow (s_sh), veh/h/ln	0	0	0	0	0	0	0	0
Perm LT Eff Green (g_p), s	0.0	0.0	0.0	0.0	0.0	30.0	0.0	0.0
Perm LT Serve Time (g_u), s	0.0	0.0	0.0	0.0	0.0	20.3	0.0	0.0
Perm LT Q Serve Time (g_ps), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time to First Blk (g_f), s	0.0	30.0	0.0	0.0	0.0	11.6	0.0	0.0
Serve Time pre Blk (g_fs), s	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0
Prop LT Inside Lane (P_L)	0.00	0.00	1.00	0.00	0.00	0.13	0.00	0.00
Lane Grp Cap (c), veh/h	0	0	220	0	0	1009	0	0
V/C Ratio (X)	0.00	0.00	0.73	0.00	0.00	0.15	0.00	0.00
Avail Cap (c_a), veh/h	0	0	621	0	0	1009	0	0
Upstream Filter (I)	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	0.0	20.2	0.0	0.0	3.8	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.0	4.6	0.0	0.0	0.3	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	0.0	24.8	0.0	0.0	4.1	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.0	1.6	0.0	0.0	0.4	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.3	0.0	0.0	0.1	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
%ile Back of Q (50%), veh/ln	0.0	0.0	1.8	0.0	0.0	0.5	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.00	0.12	0.00	0.00	0.03	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Middle Lane Group Data								
Assigned Mvmt	0	2	8	0	0	6	0	0
Lane Assignment		T						
Lanes in Grp	0	1	0	0	0	0	0	0
Grp Vol (v), veh/h	0	647	0	0	0	0	0	0
Grp Sat Flow (s), veh/h/ln	0	1870	0	0	0	0	0	0
Q Serve Time (g_s), s	0.0	9.7	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	9.7	0.0	0.0	0.0	0.0	0.0	0.0
Lane Grp Cap (c), veh/h	0	1160	0	0	0	0	0	0
V/C Ratio (X)	0.00	0.56	0.00	0.00	0.00	0.00	0.00	0.00
Avail Cap (c_a), veh/h	0	1160	0	0	0	0	0	0
Upstream Filter (I)	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0
Incr Delay (d2), s/veh	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	7.3	0.0	0.0	0.0	0.0	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0

3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
%ile Back of Q (50%), veh/ln	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Right Lane Group Data								
Assigned Mvmt	0	12	18	0	0	16	0	0
Lane Assignment		R	R					
Lanes in Grp	0	1	1	0	0	0	0	0
Grp Vol (v), veh/h	0	390	35	0	0	0	0	0
Grp Sat Flow (s), veh/h/ln	0	1560	1547	0	0	0	0	0
Q Serve Time (g_s), s	0.0	6.1	1.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	6.1	1.0	0.0	0.0	0.0	0.0	0.0
Prot RT Sat Flow (s_R), veh/h/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prot RT Eff Green (g_R), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop RT Outside Lane (P_R)	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
Lane Grp Cap (c), veh/h	0	968	204	0	0	0	0	0
V/C Ratio (X)	0.00	0.40	0.17	0.00	0.00	0.00	0.00	0.00
Avail Cap (c_a), veh/h	0	968	576	0	0	0	0	0
Upstream Filter (I)	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	4.6	18.7	0.0	0.0	0.0	0.0	0.0
Incr Delay (d2), s/veh	0.0	1.3	0.4	0.0	0.0	0.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	5.9	19.1	0.0	0.0	0.0	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	1.1	0.3	0.0	0.0	0.0	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
%ile Back of Q (50%), veh/ln	0.0	1.5	0.3	0.0	0.0	0.0	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.15	0.09	0.00	0.00	0.00	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Intersection Summary		
HCM 6th Ctrl Delay		8.9
HCM 6th LOS		A

Lane Group	WBL	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	382	40	217	191	729
Act Effct Green (s)	16.1	16.1	30.1	30.1	30.1
Actuated g/C Ratio	0.28	0.28	0.52	0.52	0.52
v/c Ratio	0.80	0.09	0.23	0.22	0.80
Control Delay	34.1	6.5	9.1	2.2	21.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	34.1	6.5	9.1	2.2	21.2
LOS	C	A	A	A	C
Approach Delay	31.4		5.9		21.2
Approach LOS	C		A		C
Queue Length 50th (ft)	123	0	41	0	207
Queue Length 95th (ft)	185	16	76	26	266
Internal Link Dist (ft)	358		415		425
Turn Bay Length (ft)		100		250	
Base Capacity (vph)	535	511	930	875	912
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.71	0.08	0.23	0.22	0.80

Intersection Summary	
Cycle Length: 60	
Actuated Cycle Length: 58.2	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.80	
Intersection Signal Delay: 20.0	Intersection LOS: B
Intersection Capacity Utilization 72.9%	ICU Level of Service C
Analysis Period (min) 15	

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	280	30	180	155	35	470
Future Volume (veh/h)	280	30	180	155	35	470
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1885	1900	1870	1856	1900	1900
Adj Flow Rate, veh/h	382	40	217	191	54	675
Peak Hour Factor	0.82	0.83	0.93	0.91	0.73	0.78
Percent Heavy Veh, %	1	0	2	3	0	0
Cap, veh/h	447	401	1003	843	112	937
Arrive On Green	0.25	0.25	0.54	0.54	0.54	0.54
Sat Flow, veh/h	1795	1610	1870	1572	80	1748
Grp Volume(v), veh/h	382	40	217	191	729	0
Grp Sat Flow(s),veh/h/ln	1795	1610	1870	1572	1827	0
Q Serve(g_s), s	11.4	1.1	3.4	3.6	4.8	0.0
Cycle Q Clear(g_c), s	11.4	1.1	3.4	3.6	16.6	0.0
Prop In Lane	1.00	1.00		1.00	0.07	
Lane Grp Cap(c), veh/h	447	401	1003	843	1049	0
V/C Ratio(X)	0.85	0.10	0.22	0.23	0.69	0.00
Avail Cap(c_a), veh/h	578	518	1003	843	1049	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	20.0	16.2	6.8	6.8	9.8	0.0
Incr Delay (d2), s/veh	9.6	0.1	0.5	0.6	3.8	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.3	0.4	1.1	1.0	5.7	0.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	29.6	16.3	7.3	7.5	13.6	0.0
LnGrp LOS	C	B	A	A	B	A
Approach Vol, veh/h	422		408			729
Approach Delay, s/veh	28.4		7.4			13.6
Approach LOS	C		A			B

Timer - Assigned Phs	2	6	8
Phs Duration (G+Y+Rc), s	36.0	36.0	19.9
Change Period (Y+Rc), s	6.0	6.0	6.0
Max Green Setting (Gmax), s	30.0	30.0	18.0
Max Q Clear Time (g_c+I1), s	5.6	18.6	13.4
Green Ext Time (p_c), s	1.8	3.7	0.6

Intersection Summary	
HCM 6th Ctrl Delay	16.0
HCM 6th LOS	B

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	280	30	180	155	35	470
Future Volume (veh/h)	280	30	180	155	35	470
Number	3	18	2	12	1	6
Initial Q, veh	0	0	0	0	0	0
Ped-Bike Adj (A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Lanes Open During Work Zone						
Adj Sat Flow, veh/h/ln	1885	1900	1870	1856	1900	1900
Adj Flow Rate, veh/h	382	40	217	191	54	675
Peak Hour Factor	0.82	0.83	0.93	0.91	0.73	0.78
Percent Heavy Veh, %	1	0	2	3	0	0
Opposing Right Turn Influence	Yes				Yes	
Cap, veh/h	447	401	1003	843	112	937
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Prop Arrive On Green	0.25	0.25	0.54	0.54	0.54	0.54
Unsig. Movement Delay						
Ln Grp Delay, s/veh	29.6	16.3	7.3	7.5	13.6	0.0
Ln Grp LOS	C	B	A	A	B	A
Approach Vol, veh/h	422		408			729
Approach Delay, s/veh	28.4		7.4			13.6
Approach LOS	C		A			B

Timer:	1	2	3	4	5	6	7	8
Assigned Phs		2	8			6		
Case No		7.0	9.0			8.0		
Phs Duration (G+Y+Rc), s		36.0	19.9			36.0		
Change Period (Y+Rc), s		6.0	6.0			6.0		
Max Green (Gmax), s		30.0	18.0			30.0		
Max Allow Headway (MAH), s		4.5	3.8			5.1		
Max Q Clear (g_c+I1), s		5.6	13.4			18.6		
Green Ext Time (g_e), s		1.8	0.6			3.7		
Prob of Phs Call (p_c)		1.00	1.00			1.00		
Prob of Max Out (p_x)		0.00	0.65			0.00		
Left-Turn Movement Data								
Assigned Mvmt		5	3			1		
Mvmt Sat Flow, veh/h		0	1795			80		
Through Movement Data								
Assigned Mvmt		2	8			6		
Mvmt Sat Flow, veh/h		1870	0			1748		
Right-Turn Movement Data								
Assigned Mvmt		12	18			16		
Mvmt Sat Flow, veh/h		1572	1610			0		
Left Lane Group Data								
Assigned Mvmt	0	5	3	0	0	1	0	0
Lane Assignment			L			L+T		

Lanes in Grp	0	0	1	0	0	1	0	0
Grp Vol (v), veh/h	0	0	382	0	0	729	0	0
Grp Sat Flow (s), veh/h/ln	0	0	1795	0	0	1827	0	0
Q Serve Time (g_s), s	0.0	0.0	11.4	0.0	0.0	4.8	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	0.0	11.4	0.0	0.0	16.6	0.0	0.0
Perm LT Sat Flow (s_l), veh/h/ln	0	0	1795	0	0	993	0	0
Shared LT Sat Flow (s_sh), veh/h/ln	0	0	0	0	0	0	0	0
Perm LT Eff Green (g_p), s	0.0	0.0	0.0	0.0	0.0	30.0	0.0	0.0
Perm LT Serve Time (g_u), s	0.0	0.0	0.0	0.0	0.0	26.6	0.0	0.0
Perm LT Q Serve Time (g_ps), s	0.0	0.0	0.0	0.0	0.0	4.8	0.0	0.0
Time to First Blk (g_f), s	0.0	30.0	0.0	0.0	0.0	11.9	0.0	0.0
Serve Time pre Blk (g_fs), s	0.0	0.0	0.0	0.0	0.0	11.9	0.0	0.0
Prop LT Inside Lane (P_L)	0.00	0.00	1.00	0.00	0.00	0.07	0.00	0.00
Lane Grp Cap (c), veh/h	0	0	447	0	0	1049	0	0
V/C Ratio (X)	0.00	0.00	0.85	0.00	0.00	0.69	0.00	0.00
Avail Cap (c_a), veh/h	0	0	578	0	0	1049	0	0
Upstream Filter (I)	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	0.0	20.0	0.0	0.0	9.8	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.0	9.6	0.0	0.0	3.8	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	0.0	29.6	0.0	0.0	13.6	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.0	4.1	0.0	0.0	4.6	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.0	1.2	0.0	0.0	1.1	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
%ile Back of Q (50%), veh/ln	0.0	0.0	5.3	0.0	0.0	5.7	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.00	0.34	0.00	0.00	0.30	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Middle Lane Group Data								
Assigned Mvmt	0	2	8	0	0	6	0	0
Lane Assignment		T						
Lanes in Grp	0	1	0	0	0	0	0	0
Grp Vol (v), veh/h	0	217	0	0	0	0	0	0
Grp Sat Flow (s), veh/h/ln	0	1870	0	0	0	0	0	0
Q Serve Time (g_s), s	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0
Lane Grp Cap (c), veh/h	0	1003	0	0	0	0	0	0
V/C Ratio (X)	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00
Avail Cap (c_a), veh/h	0	1003	0	0	0	0	0	0
Upstream Filter (I)	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	6.8	0.0	0.0	0.0	0.0	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	7.3	0.0	0.0	0.0	0.0	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0

3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
%ile Back of Q (50%), veh/ln	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Right Lane Group Data								
Assigned Mvmt	0	12	18	0	0	16	0	0
Lane Assignment		R	R					
Lanes in Grp	0	1	1	0	0	0	0	0
Grp Vol (v), veh/h	0	191	40	0	0	0	0	0
Grp Sat Flow (s), veh/h/ln	0	1572	1610	0	0	0	0	0
Q Serve Time (g_s), s	0.0	3.6	1.1	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	3.6	1.1	0.0	0.0	0.0	0.0	0.0
Prot RT Sat Flow (s_R), veh/h/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prot RT Eff Green (g_R), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop RT Outside Lane (P_R)	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
Lane Grp Cap (c), veh/h	0	843	401	0	0	0	0	0
V/C Ratio (X)	0.00	0.23	0.10	0.00	0.00	0.00	0.00	0.00
Avail Cap (c_a), veh/h	0	843	518	0	0	0	0	0
Upstream Filter (I)	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	6.8	16.2	0.0	0.0	0.0	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.6	0.1	0.0	0.0	0.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	7.5	16.3	0.0	0.0	0.0	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.8	0.4	0.0	0.0	0.0	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
%ile Back of Q (50%), veh/ln	0.0	1.0	0.4	0.0	0.0	0.0	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.10	0.09	0.00	0.00	0.00	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Intersection Summary								
HCM 6th Ctrl Delay		16.0						
HCM 6th LOS		B						

Lane Group	WBL	WBR	NBT	SBT
Lane Group Flow (vph)	160	35	964	152
Act Effct Green (s)	13.0	13.0	54.0	54.0
Actuated g/C Ratio	0.16	0.16	0.68	0.68
v/c Ratio	0.62	0.13	0.81	0.15
Control Delay	40.0	10.4	16.9	5.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	40.0	10.4	16.9	5.6
LOS	D	B	B	A
Approach Delay	34.7		16.9	5.6
Approach LOS	C		B	A
Queue Length 50th (ft)	69	0	264	22
Queue Length 95th (ft)	127	18	#490	52
Internal Link Dist (ft)	358		415	425
Turn Bay Length (ft)		100		
Base Capacity (vph)	361	366	1187	1003
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.44	0.10	0.81	0.15

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 79.1
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 18.3 Intersection LOS: B
Intersection Capacity Utilization 64.4% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	130	25	485	260	10	110
Future Volume (veh/h)	130	25	485	260	10	110
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1752	1826	1870	1841	1900	1752
Adj Flow Rate, veh/h	160	35	647	317	20	132
Peak Hour Factor	0.91	0.79	0.84	0.92	0.56	0.93
Percent Heavy Veh, %	10	5	2	4	0	10
Cap, veh/h	206	191	838	410	121	735
Arrive On Green	0.12	0.12	0.71	0.71	0.71	0.71
Sat Flow, veh/h	1668	1547	1185	581	90	1040
Grp Volume(v), veh/h	160	35	0	964	152	0
Grp Sat Flow(s),veh/h/ln	1668	1547	0	1766	1129	0
Q Serve(g_s), s	6.6	1.4	0.0	24.9	1.5	0.0
Cycle Q Clear(g_c), s	6.6	1.4	0.0	24.9	26.5	0.0
Prop In Lane	1.00	1.00		0.33	0.13	
Lane Grp Cap(c), veh/h	206	191	0	1248	856	0
V/C Ratio(X)	0.78	0.18	0.00	0.77	0.18	0.00
Avail Cap(c_a), veh/h	425	394	0	1248	856	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	30.1	27.8	0.0	6.7	4.5	0.0
Incr Delay (d2), s/veh	6.2	0.5	0.0	4.7	0.5	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.8	0.5	0.0	6.8	0.5	0.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	36.2	28.3	0.0	11.4	5.0	0.0
LnGrp LOS	D	C	A	B	A	A
Approach Vol, veh/h	195		964			152
Approach Delay, s/veh	34.8		11.4			5.0
Approach LOS	C		B			A

Timer - Assigned Phs	2	6	8
Phs Duration (G+Y+Rc), s	56.0	56.0	14.7
Change Period (Y+Rc), s	6.0	6.0	6.0
Max Green Setting (Gmax), s	50.0	50.0	18.0
Max Q Clear Time (g_c+I1), s	26.9	28.5	8.6
Green Ext Time (p_c), s	8.1	0.8	0.4

Intersection Summary	
HCM 6th Ctrl Delay	14.1
HCM 6th LOS	B

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	130	25	485	260	10	110
Future Volume (veh/h)	130	25	485	260	10	110
Number	3	18	2	12	1	6
Initial Q, veh	0	0	0	0	0	0
Ped-Bike Adj (A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Lanes Open During Work Zone						
Adj Sat Flow, veh/h/ln	1752	1826	1870	1841	1900	1752
Adj Flow Rate, veh/h	160	35	647	317	20	132
Peak Hour Factor	0.91	0.79	0.84	0.92	0.56	0.93
Percent Heavy Veh, %	10	5	2	4	0	10
Opposing Right Turn Influence	Yes				Yes	
Cap, veh/h	206	191	838	410	121	735
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Prop Arrive On Green	0.12	0.12	0.71	0.71	0.71	0.71
Unsig. Movement Delay						
Ln Grp Delay, s/veh	36.2	28.3	0.0	11.4	5.0	0.0
Ln Grp LOS	D	C	A	B	A	A
Approach Vol, veh/h	195		964			152
Approach Delay, s/veh	34.8		11.4			5.0
Approach LOS	C		B			A

Timer:	1	2	3	4	5	6	7	8
Assigned Phs		2	8			6		
Case No		8.0	9.0			8.0		
Phs Duration (G+Y+Rc), s		56.0	14.7			56.0		
Change Period (Y+Rc), s		6.0	6.0			6.0		
Max Green (Gmax), s		50.0	18.0			50.0		
Max Allow Headway (MAH), s		5.1	3.8			5.5		
Max Q Clear (g_c+I1), s		26.9	8.6			28.5		
Green Ext Time (g_e), s		8.1	0.4			0.8		
Prob of Phs Call (p_c)		1.00	0.98			1.00		
Prob of Max Out (p_x)		0.00	0.01			0.00		
Left-Turn Movement Data								
Assigned Mvmt		5	3			1		
Mvmt Sat Flow, veh/h		0	1668			90		
Through Movement Data								
Assigned Mvmt		2	8			6		
Mvmt Sat Flow, veh/h		1185	0			1040		
Right-Turn Movement Data								
Assigned Mvmt		12	18			16		
Mvmt Sat Flow, veh/h		581	1547			0		
Left Lane Group Data								
Assigned Mvmt	0	5	3	0	0	1	0	0
Lane Assignment			L			L+T		

Lanes in Grp	0	0	1	0	0	1	0	0
Grp Vol (v), veh/h	0	0	160	0	0	152	0	0
Grp Sat Flow (s), veh/h/ln	0	0	1668	0	0	1129	0	0
Q Serve Time (g_s), s	0.0	0.0	6.6	0.0	0.0	1.5	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	0.0	6.6	0.0	0.0	26.5	0.0	0.0
Perm LT Sat Flow (s_l), veh/h/ln	0	0	1668	0	0	592	0	0
Shared LT Sat Flow (s_sh), veh/h/ln	0	0	0	0	0	0	0	0
Perm LT Eff Green (g_p), s	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0
Perm LT Serve Time (g_u), s	0.0	0.0	0.0	0.0	0.0	25.1	0.0	0.0
Perm LT Q Serve Time (g_ps), s	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0
Time to First Blk (g_f), s	0.0	50.0	0.0	0.0	0.0	12.8	0.0	0.0
Serve Time pre Blk (g_fs), s	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
Prop LT Inside Lane (P_L)	0.00	0.00	1.00	0.00	0.00	0.13	0.00	0.00
Lane Grp Cap (c), veh/h	0	0	206	0	0	856	0	0
V/C Ratio (X)	0.00	0.00	0.78	0.00	0.00	0.18	0.00	0.00
Avail Cap (c_a), veh/h	0	0	425	0	0	856	0	0
Upstream Filter (I)	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	0.0	30.1	0.0	0.0	4.5	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.0	6.2	0.0	0.0	0.5	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	0.0	36.2	0.0	0.0	5.0	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.0	2.5	0.0	0.0	0.4	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.4	0.0	0.0	0.1	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
%ile Back of Q (50%), veh/ln	0.0	0.0	2.8	0.0	0.0	0.5	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.00	0.19	0.00	0.00	0.03	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Middle Lane Group Data								
Assigned Mvmt	0	2	8	0	0	6	0	0
Lane Assignment								
Lanes in Grp	0	0	0	0	0	0	0	0
Grp Vol (v), veh/h	0	0	0	0	0	0	0	0
Grp Sat Flow (s), veh/h/ln	0	0	0	0	0	0	0	0
Q Serve Time (g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane Grp Cap (c), veh/h	0	0	0	0	0	0	0	0
V/C Ratio (X)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avail Cap (c_a), veh/h	0	0	0	0	0	0	0	0
Upstream Filter (I)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

APPENDIX 3

TRAFFIC SIGNAL WARRANTS ANALYSIS

Signal Warrant 1

			Major Street			Minor Street			
		Name:	VT 116			VT 2A			
			EB	WB	Total EB+WB		SB	MAX (Minor)	Warrant 1A
6:00	-	7:00	535	38	573		63	63	
7:00	-	8:00	739	109	848		132	132	
8:00	-	9:00	619	122	741		144	144	MEETS
9:00	-	10:00	365	115	480		122	122	
10:00	-	11:00	345	124	469		155	155	MEETS
11:00	-	12:00	306	169	475		146	146	MEETS
12:00	-	13:00	348	166	514		153	153	MEETS
13:00	-	14:00	290	162	452		175	175	MEETS
14:00	-	15:00	291	200	491		216	216	MEETS
15:00	-	16:00	324	290	614		257	257	MEETS
16:00	-	17:00	349	449	798		283	283	MEETS
17:00	-	18:00	305	474	779		334	334	MEETS

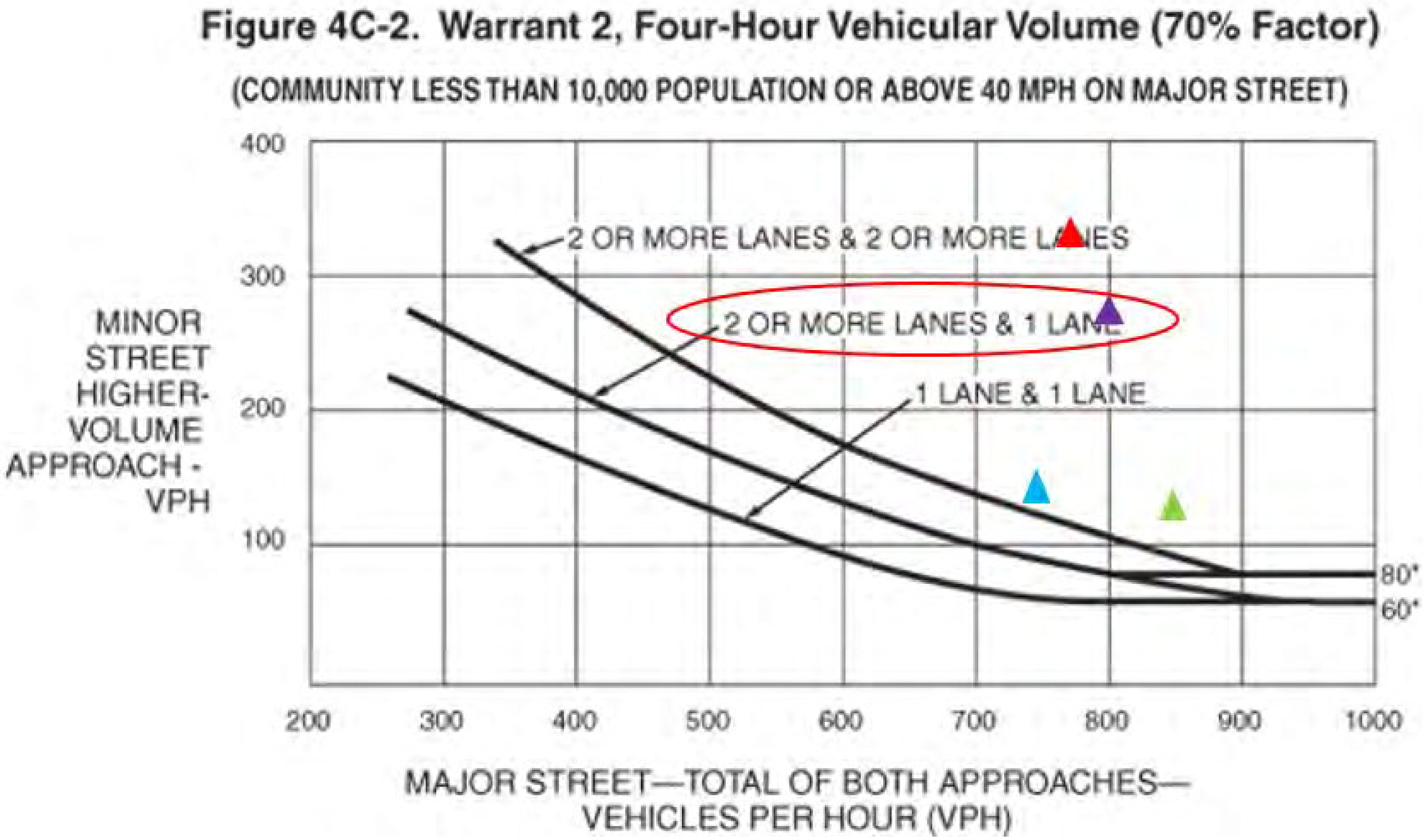
Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

Condition A—Minimum Vehicular Volume

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

[c] May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000

Signal Warrant 2



	Major	Minor
7:00	848	132
8:00	741	144
16:00	798	283
17:00	779	334

APPENDIX 4

RESOURCE IDENTIFICATION MEMO

OFFICE MEMORANDUM

AOT - PDB - ENVIRONMENTAL SECTION

RESOURCE IDENTIFICATION COMPLETION MEMO

TO: Erin Parizo, Project Manager
FROM: Julie Ann Held, Environmental Specialist; Prepared by Solomon Lew-Raskin-Environmental Temp
DATE: June 2, 2021
Project: St. George STP 021-1(36)

ENVIRONMENTAL RESOURCES:

Resource	Yes	No	Comments
Archaeological Resources:	X		See Archaeological Resource ID Memo
Historic Resources:			See Historic Resource ID Memo
Wetlands:	X		See Natural Resource ID Memo
Agricultural Soils:		X	See Natural Resource ID Memo
Wildlife Habitat:	X		See Natural Resource ID Memo
Endangered Species:	X		See Natural Resource ID Memo
Stormwater Considerations:	X		See Stormwater Resource ID Memo
6(f) Properties:		X	
Hazardous Waste:		X	
Urban Background Area:		X	
Wild Scenic Rivers:		X	
Act 250 Permits:		X	
FEMA Floodplains:		X	
Flood Hazard Area:		X	
River Corridor:	X		There is a mapped river corridor within the proposed limits. If there are impacts to the bank or river, a River Management Consultation will be required.
US Coast Guard:		X	
Lakes and Ponds:		X	
Other:		X	

cc:
Project File

Jeannine Russell
VTrans Archaeology Officer
State of Vermont
Environmental Section
One National Life Drive
Montpelier, VT 05633-5001
802-477-3460 phone
Jeannine.russell@vermont.gov

Agency of Transportation

To: JulieAnn Held, Environmental Specialist

From: Jeannine Russell, VTrans Archaeology Officer

Date: May 20, 2021

Subject: St. George STP 021-1(36) Intersection Improvement Project – Archaeological Resource ID

The scope of this project has not yet been fully designed but will seek to improve the intersection of VT 2A and VT 116 in St. George. Various alternatives are being considered that may include geometric changes, signals or a roundabout so we have been asked to look at a large area to note any resource concerns. The initial study area is depicted on the attached images and is the maximum area needed for any of the proposed options being considered.

The general project area is situated within the Champlain Valley area on the eastern edge of the area that made up glacial Lake Vermont and at the base of Mount Pritchard to the east. A geographic map with the Lake Vermont overlay shows numerous known Native American sites that are situated along this area. Currently this landform is characterized by rolling hills and valleys generally bordered by Shelburne Pond to the west and Lake Iroquois to the east. Patrick Brook connects Lake Iroquois to the LaPlatte River south of the general project area and eventually leads to Lake Champlain as it connects with other drainages in the area. These environmental factors combined with a high number of known sites contribute to the high archaeological sensitivity of the overall project area.

The VTrans Archaeology Officer visited the site on May 17, 2021 to better assess the archaeological potential of the area and to take soil core samples.

The project area east of VT 116 and the 2A junction consists of a large high terrace overlooking a drainage and lower terrace to the east. Soils along the higher terrace consist of Munson and Raynham silt loams and are relatively level. The drainage includes associated wetland areas and the lower terraces are yards for a residential area. Soils along the lower terrace consist of both Peacham stony silt loam and Hartland very fine sandy loam that ranges from 2-12%. The entire upper terrace and any portions of the lower terraces not affected by underground utilities or other previous disturbances for the residences are considered archaeologically sensitive. There is a small area near the intersection east of 2A that looks like it has been previously disturbed. Remnants of a former drive can be seen from the surface and the soils here are very hard and compact. Soil cores were not possible here. Overhead lines bisected the field and evidence of a gas line could be seen. The extent of disturbance here could not be entirely verified so if this field is impacted, it is recommended that Phase 1 studies be conducted here to assess the soils and determine if a site exists within the proposed impact area.

The western (southwestern) area south of VT 116 is situated on a sloping terrace. This is also the location of Rocky Ridge Golf Course and Country Club. The upper portion of the land contains the main building and parking lots. Soils along this ridge consist of Groton gravelly fine sandy loam at 15-20% slopes. There is a gas line marker opposite the intersection and situated in between a line of hedge trees. Soil cores taken between the hedge row and edge of road shoulder, revealed intact soils consisting of fine sandy loam to a high percentage of clay soils. The terrain on the golf course is rolling and appears to have had some landscaping but due to the nature of the property, no soil cores were taken within the golf course. While there may be some areas of prior disturbance associated with the golf course, the extent is unknown at this time and therefore, the general area is considered archaeologically sensitive and Phase 1 studies are recommended if this area is to be impacted.

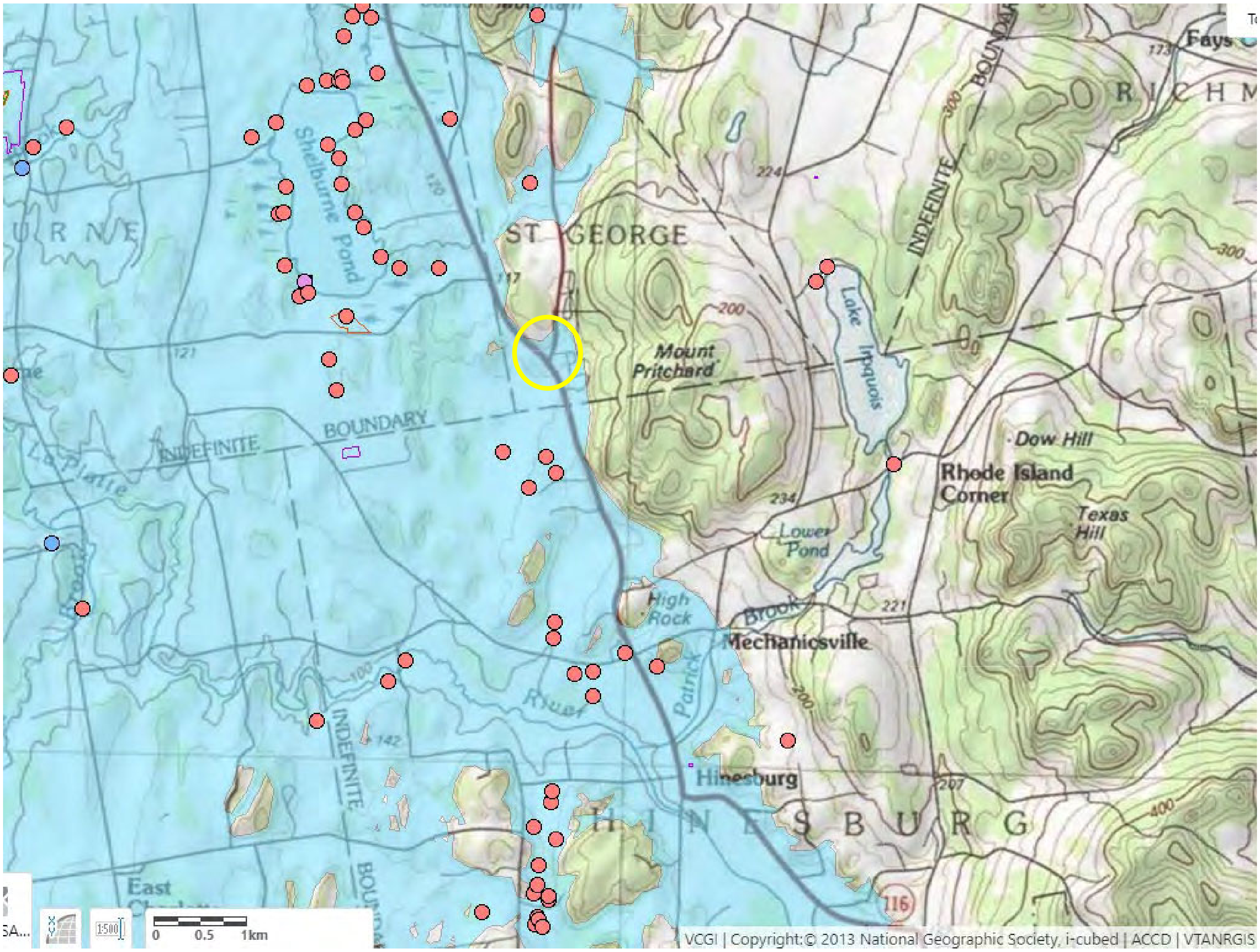
The northern section of the project area contains a residential house lot. Soils in this portion are also Munson and Raynham silt loams. There is a steep slope upward from VT 2A and an existing ditch between the house lot and roadway. The level areas of this house lot that have not been previously disturbed are considered archaeologically sensitive.

In conclusion, the majority of the project area can be considered archaeologically sensitive with the exception of the immediate areas along the roadway such as ditches or underground utilities. The VTrans Archaeology Officer recommends further study for any areas that will be impacted by the chosen alternative.

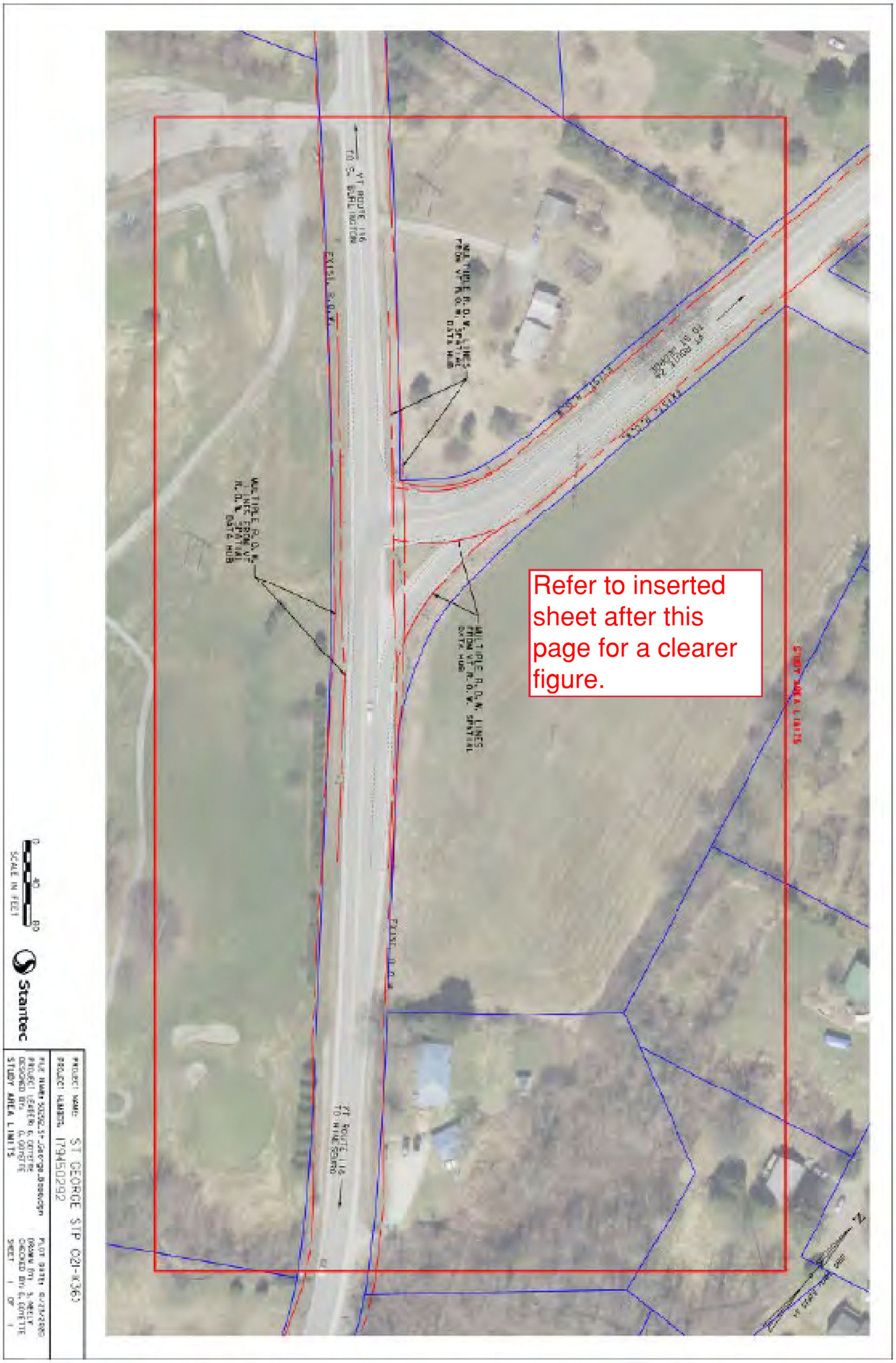
See attached maps and areas of archaeological sensitivity included with this report.
Please let me know if you have any questions.

Jeannine Russell

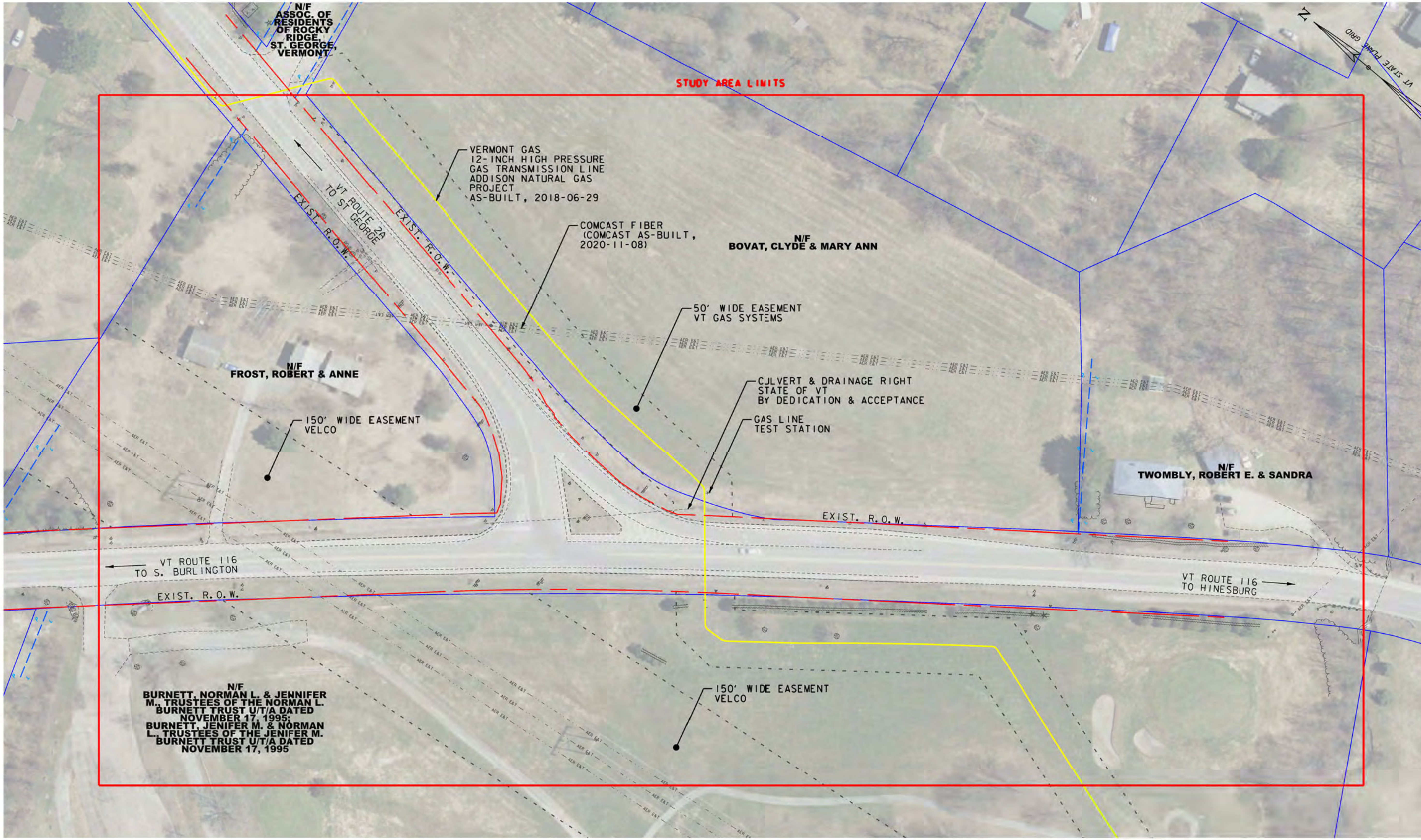
Thank you,
Jen Russell
VTrans Archaeology Officer



Project location (in yellow) on ORC map. Known Pre-Contact sites in red. Blue shading indicates boundaries of glacial Lake Vermont (Lower Fort Ann Phase)



Study area overlaid on an orthophoto. Property parcels outlined in blue.
Study area for the ARA outlined in red.



0 40 80
SCALE IN FEET

Stantec

PROJECT NAME:	ST GEORGE STP 021-1(36)
PROJECT NUMBER:	179450292

FILE NAME: 50292_St_George_Base.dgn	PLOT DATE: 5/14/2021
PROJECT LEADER: G. GOYETTE	DRAWN BY: S. NEELY
DESIGNED BY: S. NEELY	CHECKED BY: G. GOYETTE
STUDY AREA LIMITS	SHEET 1 OF 1

ArcMap showing areas of arch sensitivity within the study area boundaries

VERMONT

Vermont Agency of Transportation
Project Delivery Bureau - Environmental Section
219 North Main Street
Barre, VT 05641

To: JulieAnn Held, Environmental Specialist

From: Judith Williams Ehrlich, VTrans Historic Preservation Officer

Date: May 21, 2021

Subject: Historic Resource Identification for St. George 021-1(36)

I have completed a resource identification (ID) for St. George 021-1(36). At this time, project designers are exploring options for improving the intersection at Routes 2A and 116 in St. George and have asked for resource identification information to help guide the design decisions. I visited the project location on May 17, 2021.

This Resource Identification effort is being undertaken to provide information to the VTrans designers working on a proposed improvement project. Toward that end, VTrans Cultural Resources staff have identified potential resources within a broad preliminary Area of Potential Effect to ensure the designers are aware of all cultural resources that could possibly be affected by a project. Once the project is defined at the Conceptual Design phase, Cultural Resources staff will be able to determine a formal Area of Potential Effect for purposes of Section 106 and 22 VSA § 14.

There are seven properties in the project study area the project designer provided. Only one was identified as historic, Property 1: 7601 Route 116, House and outbuilding. Please see below for details:

Property 1: 7601 Route 116, House and outbuilding: This property is known historically as the Lockwood-Peet House and was constructed in 1830. The property was listed on the State Register of Historic Places in 1993 and has changed minimally since that time. It is eligible for listing on the National Register as a rare surviving property that represents the early agricultural heritage of St. George. **Historic**.

Property 2: Route 2A/Route 116, Open field: **Not historic.**

Property 3: 313 Rocky Ridge Circle, House: I have determined that this property does not possess the distinctive characteristics of building type, period and method of construction, or quality of significance to be considered eligible for inclusion on the National Register of Historic Places. **Not historic.**

Property 4: Peet Road, Garage: I have determined that this property does not possess the distinctive characteristics of building type, period and method of construction, or quality of significance to be considered eligible for inclusion on the National Register of Historic Places. **Not historic.**

Property 5: 46 Peet Road, House: I have determined that this property does not possess the distinctive characteristics of building type, period and method of construction, or quality of significance to be considered eligible for inclusion on the National Register of Historic Places. **Not historic.**

Property 6: 7673 Route 116, House: I have determined that this property does not possess the distinctive characteristics of building type, period and method of construction, or quality of significance to be considered eligible for inclusion on the National Register of Historic Places. **Not historic.**

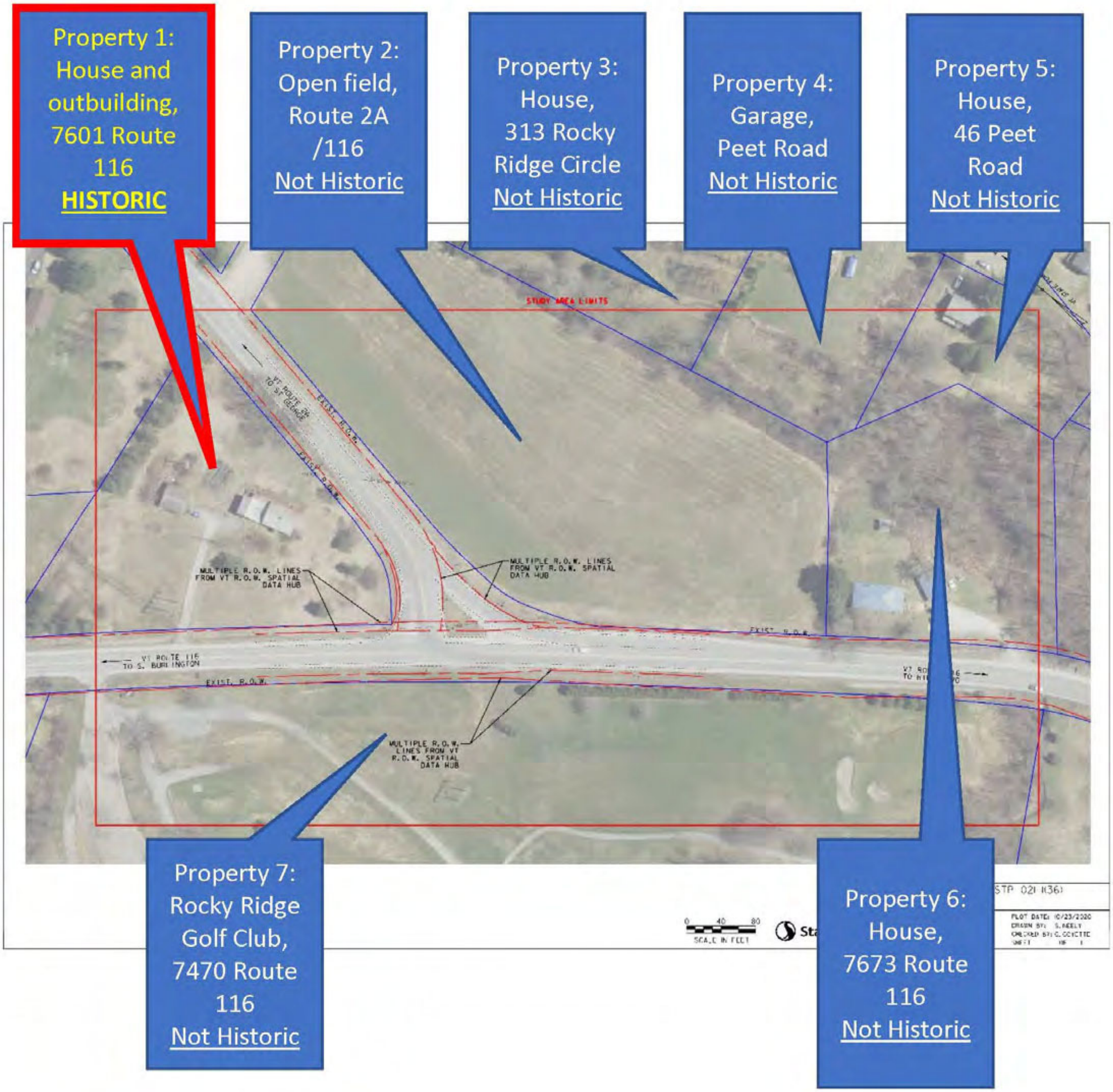
Property 7: 7470 Route 116, Rocky Ridge Golf Club: This private golf club opened in 1963. The club house is less than fifty years old, however, and does not possess the characteristics of building type, period and method of construction, or quality of significance to be considered eligible for inclusion on the National Register of Historic Places. **Not historic.**

There is one 4(f) property type within the project area: the historic Property 1: 7601 Route 116, House and outbuilding.

Please do not hesitate to contact me should you require additional information.

Attachments

- Project study area
- Photos



Project study area.

Property 1: 7601 Route 116, House and outbuilding: **Historic**.

Property 3: 313 Rocky Ridge Circle, House: Not historic.


Property 4: Peet Road, Garage: Not historic.

Property 5: 46 Peet Road, House:

Property 6: 7673 Route 116, House: Not historic (Image from Google Earth).


Property 7: 7470 Route 116, Rocky Ridge Golf Club club house: Not historic (image from Golf Club website).

VERMONT

State of Vermont
Highways-PDB-Environmental
219 N. Main Street
www.aot.state.vt.us

Agency of Transportation

To: Julie Ann Held, VTrans Environmental Specialist

From: Glenn Gingras, VTrans Environmental Biologist

Date: 5/5/2021

Subject: St. George STP 021-1(36)- Natural Resource ID

I have completed my natural resource identification for the above referenced project. My evaluation has included wetlands, wildlife habitat, agricultural soils, and rare, threatened, and endangered species. The project area reviewed included the area within figure 1.

Figure 1

Wetlands/Watercourses
A field visit was completed to determine the presence/absence of regulated wetlands in the project area. One wetland was identified within the southeast portion of the project area. The wetland is a class II wetland and would have a regulated 50' buffer. The wetland area is shown within figure 2. The natural resource dgn will included in the resource ID folder has the locational information.

Figure 2

An unnamed tributary of the LaPlatte River flows westerly through the project area. The stream crosses VT Route 116 at the most southerly limits of the project area.

Avoidance and minimization of these resources is required in any alternative design for this intersection. Coordination and permitting will be required if the stream and wetlands are impacted with resource regulatory agencies.

Wildlife Habitat

Most of the project area is open agricultural lands. The unnamed tributary's riparian corridor presents the most important habitat value in the project area. Intact riparian zones are of high priority to a variety of aquatic and terrestrial species as well as water quality, flood attenuation and erosion prevention according to ANR's Bio Finder mapping. The riparian zone should be avoided if possible, during the development of this project.

Rare, Threatened and Endangered Species (RTE)
I have queried the ANR Natural Resource database for occurrences of RTE species and significant natural communities within the vicinity of the project.

The project is within the summer range of the Indiana Bat (federally endangered) and the northern long-eared bat (federally threatened). No known hibernacula's or known roost tree locations are present within 1-mile of the project area. During the field investigation no potential roost trees were identified within the project area.

Agricultural Soils:
The soils in the project area are mapped as Munson and Raynham silt loams. These soils are classified as Statewide (b). No prime agricultural soils are mapped in the project area.

Invasive Species
No invasive species were identified within the project area.

State of Vermont
Environmental Section
219 North Main Street
Barre, Vermont 05641
Vtrans.vermont.gov

Agency of Transportation

[phone] 802-595-9143

To: Julie Ann Held, VTrans Environmental Specialist
From: Jon Armstrong, Stormwater Management Engineer
Date: May 21, 2021
Subject: St. George 021-1(36)- Stormwater Resource ID Review

Project Description: I have reviewed the project area for stormwater related regulatory and water quality concerns. This project involves improving the intersection at Routes 2A and 116 in St. George. A scoping study is being developed by the design team with options ranging from geometric changes, to a signal, to a roundabout.

My evaluation has included the review of existing imagery and mapping (ANR Natural Resource Atlas, VTrans Operational Stormwater Permits) to capture existing stormwater features and existing drainage. A site visit was conducted.

Regulatory Considerations

It is uncertain at this time whether an Operational Stormwater permit will be required for this project as the scope and extent of the project has not been determined. Some options being explored could trigger jurisdiction for a permit. If an operational SW permit is not triggered, but a construction SW permit is, the project will likely need to follow the TS4 "Gap" procedure and incorporate feasible post construction treatment measures. There are no existing stormwater permits near the site area. No formal stormwater treatment is located within the ROW.

The following are not noteworthy stormwater regulatory concerns at this time:

This project site is not within a designated groundwater public water supply source protection area.
The project site is not located within a stormwater impaired (303(d) list) watershed.
The receiving water is not listed as stressed, nor it is considered an outstanding resource water.

Existing Drainage

The project area drainage largely consists of grass and stone lined swales with some sheet flow into the adjacent gold course. There are two 15" CMP culverts under VT2a at the intersection with VT116 with a DI in the island. According to the VTrans small culvert inventory, the culverts (last inspected in 2017) are in relatively poor condition. The outlet of the culvert is largely buried and there is some erosion in the grass lined portion of the swale below the outlet. The project area drains towards the south to an unnamed perennial tributary to the LaPlatte River.

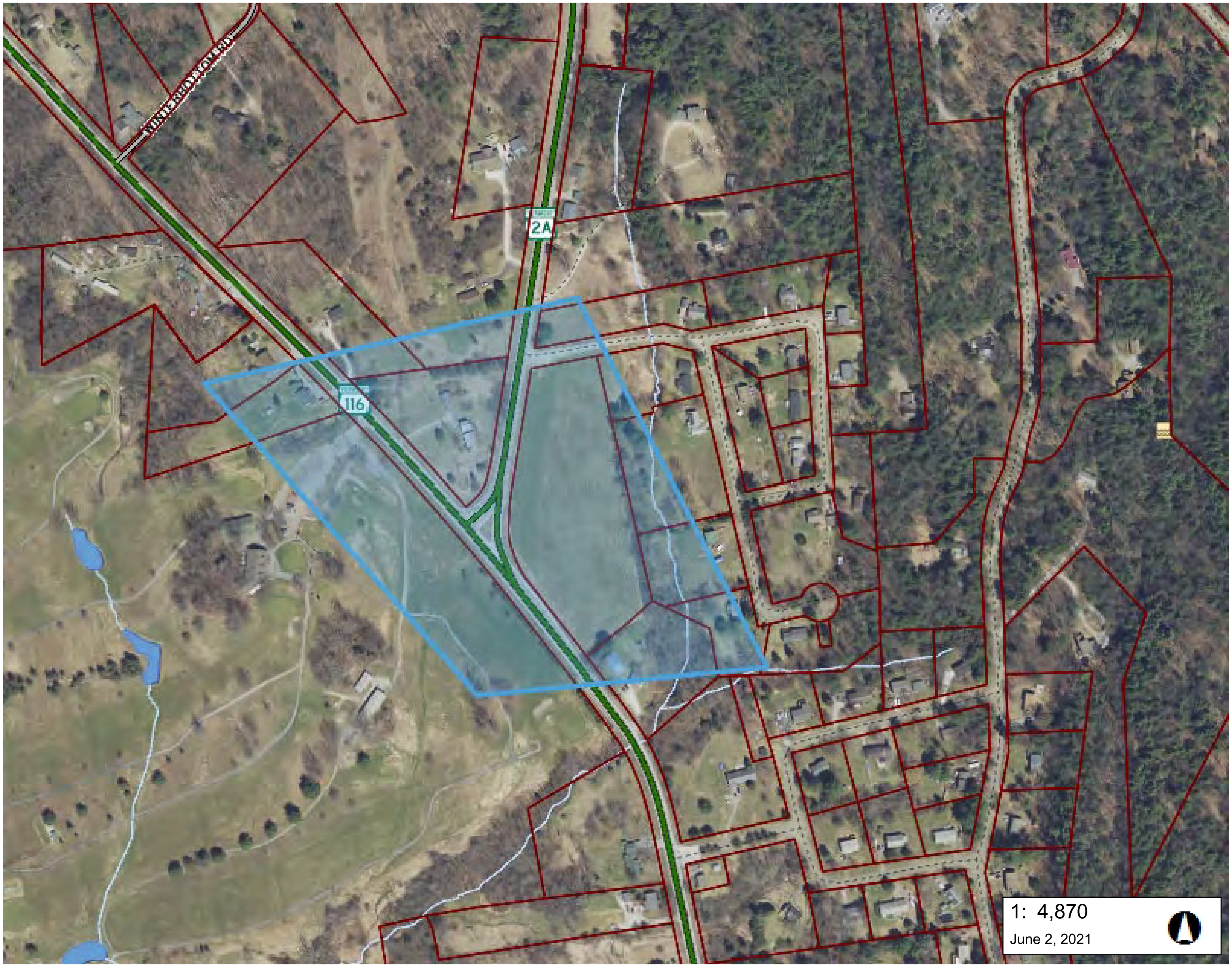
Design Considerations

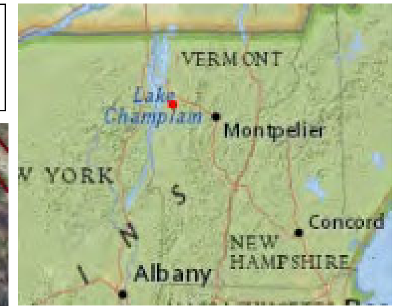
To the extent feasible, sheet flow through vegetation should be encouraged with the design. Any erosion in the swales should be stabilized and the culverts likely should be replaced. Soils in the project area are shown as hydrologic soil group C/D, which are not well suited for infiltration practices.

Hazardous Waste Urban Soils Map

Vermont Agency of Natural Resources

vermont.gov





LEGEND

Landfills
- OPERATING
- CLOSED

Land Use Restrictions
- Class IV GW Reclass
- Class VI GW Reclass
- Deed Restriction
- Easement
- Land Record Notice
- Other

Hazardous Site

Hazardous Waste Generators

Brownfields

Salvage Yard

Aboveground Storage Tank

Underground Storage Tank (w

Dry Cleaner

Urban Soil Background Areas

Parcels (standardized)

Act250 Permits **INCOMPLET

Roads
- Interstate
- US Highway; 1
- State Highway
- Town Highway (Class 1)
- Town Highway (Class 2,3)
- Town Highway (Class 4)

1: 4,870

June 2, 2021

247.0 | 0 | 124.00 | 247.0 Meters

WGS_1984_Web_Mercator_Auxiliary_Sphere

1" = 406 Ft. 1cm = 49 Meters

THIS MAP IS NOT TO BE USED FOR NAVIGATION

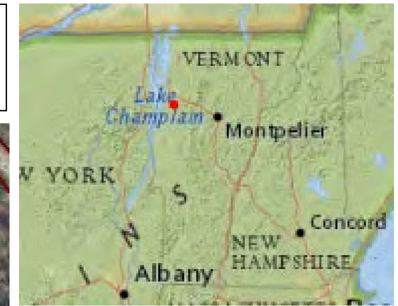
NOTES

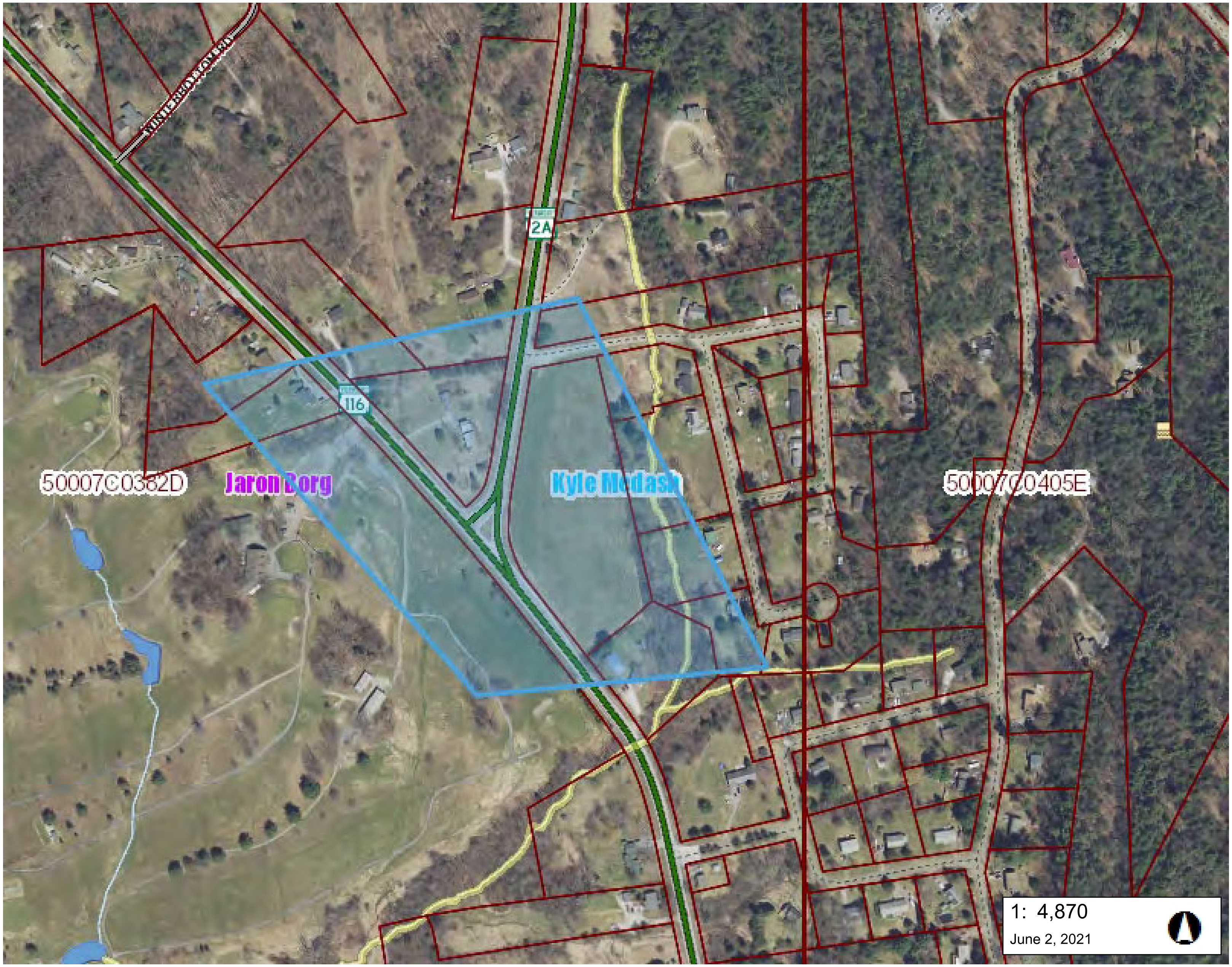
Map created using ANR's Natural Resources Atlas

Floodplains Rivers Map

Vermont Agency of Natural Resources

vermont.gov





1: 4,870

June 2, 2021

LEGEND

- DFIRM X-Sections
- DFIRM - Letter of Map Revisio
- DFIRM Panels
- DFIRM Floodways
- Flood Hazard Areas (Only FEM
  - AE (1-percent annual chance flood
  - A (1-percent annual chance floodpl
  - AO (1-percent annual chance zone feet)
  - 0.2-percent annual chance flood ha
- River Corridors (Aug 27, 2019)
- .5 - 2 sqmi.
- .25-.5 sqmi.
- River Corridor Easement
- River Management Engineer D
- Floodplain Manager Regions
- Parcels (standardized)
- Act250 Permits **INCOMPLET
- Roads
  - Interstate
  - US Highway; 1
  - State Highway
  - Town Highway (Class 1)
  - Town Highway (Class 2,3)
  - Town Highway (Class 4)
  - State Forest Trail
  - National Forest Trail
  - Legal Trail

NOTES

Map created using ANR's Natural Resources Atlas

247.0 | 0 | 124.00 | 247.0 Meters

WGS_1984_Web_Mercator_Auxiliary_Sphere

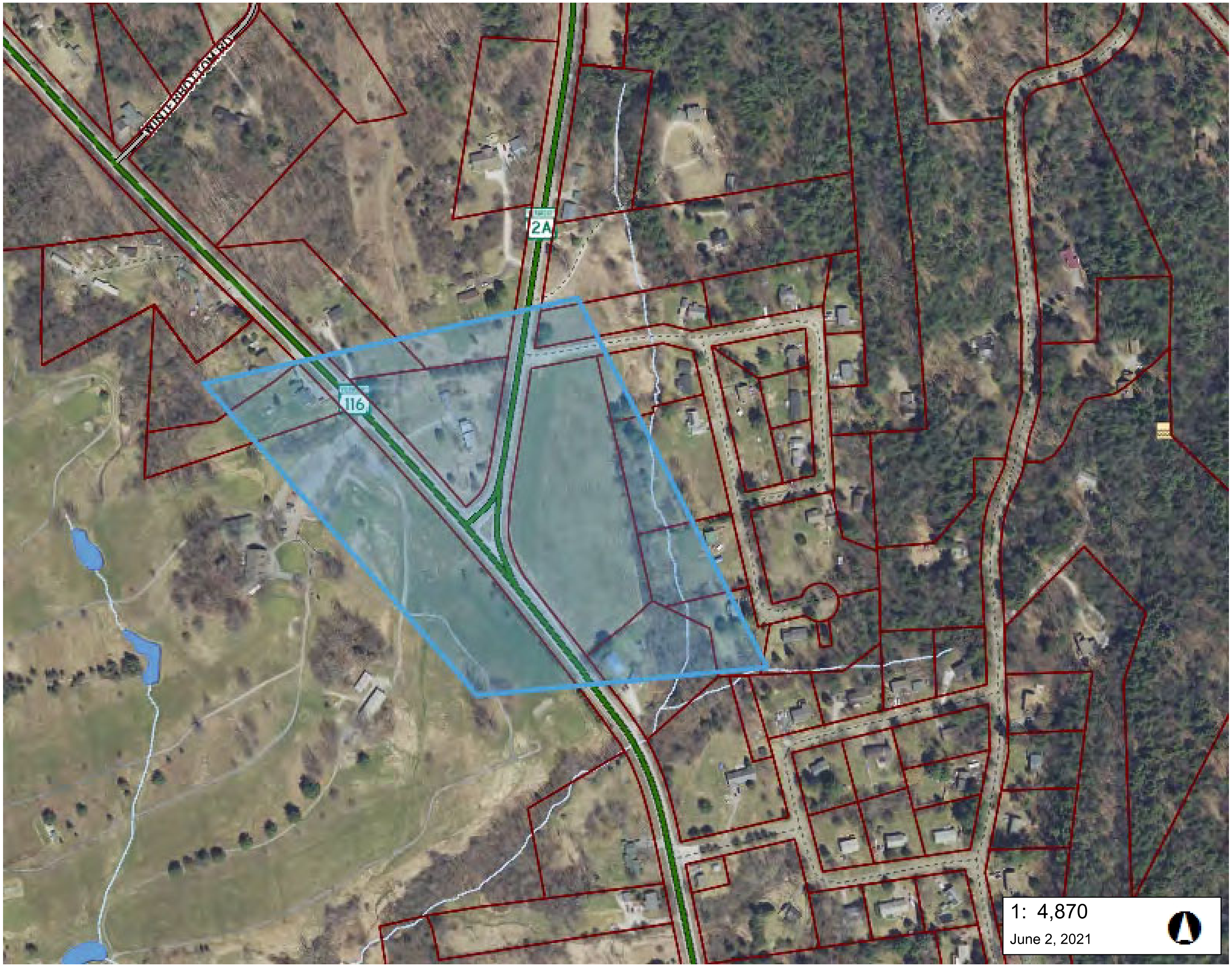
1" = 406 Ft. 1cm = 49 Meters

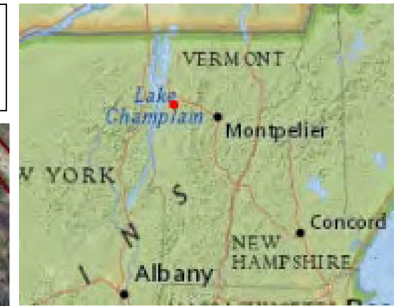
THIS MAP IS NOT TO BE USED FOR NAVIGATION

Other Resources Map

Vermont Agency of Natural Resources

vermont.gov





LEGEND

Parcels (standardized)

Act250 Permits **INCOMPLET

Roads

- Interstate
- US Highway; 1
- State Highway
- Town Highway (Class 1)
- Town Highway (Class 2,3)
- Town Highway (Class 4)
- State Forest Trail
- National Forest Trail
- Legal Trail
- Private Road/Driveway
- Proposed Roads

Waterbody

Stream/River

- Stream
- Intermittent Stream

Town Boundary

247.0 | 0 | 124.00 | 247.0 Meters

WGS_1984_Web_Mercator_Auxiliary_Sphere

1" = 406 Ft. 1cm = 49 Meters

THIS MAP IS NOT TO BE USED FOR NAVIGATION

NOTES

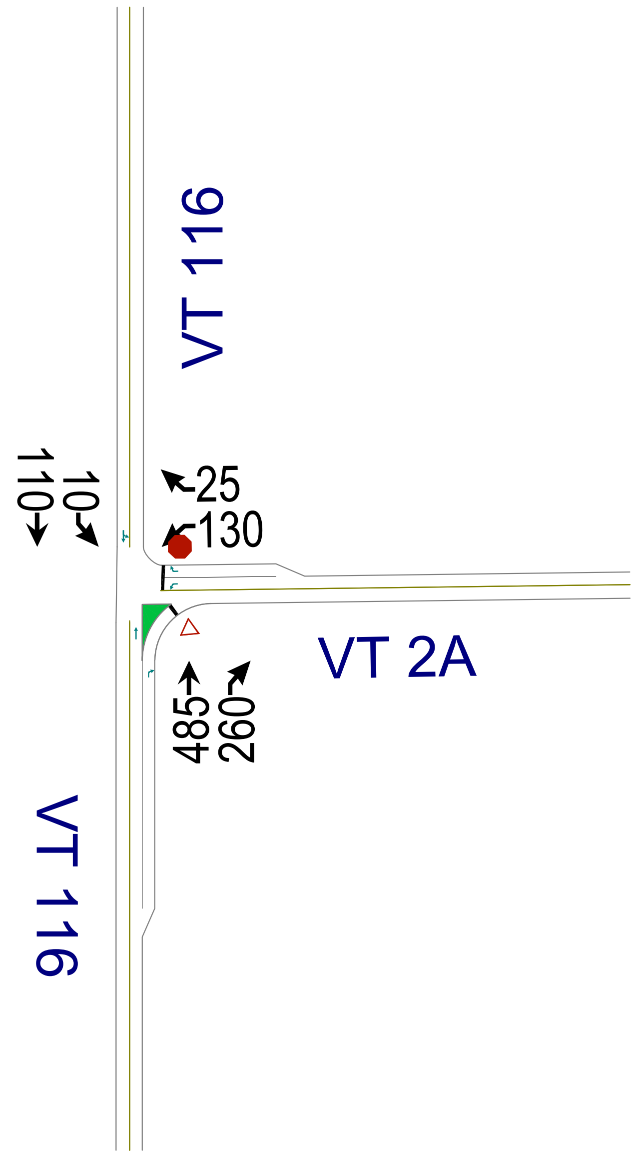
Map created using ANR's Natural Resources Atlas

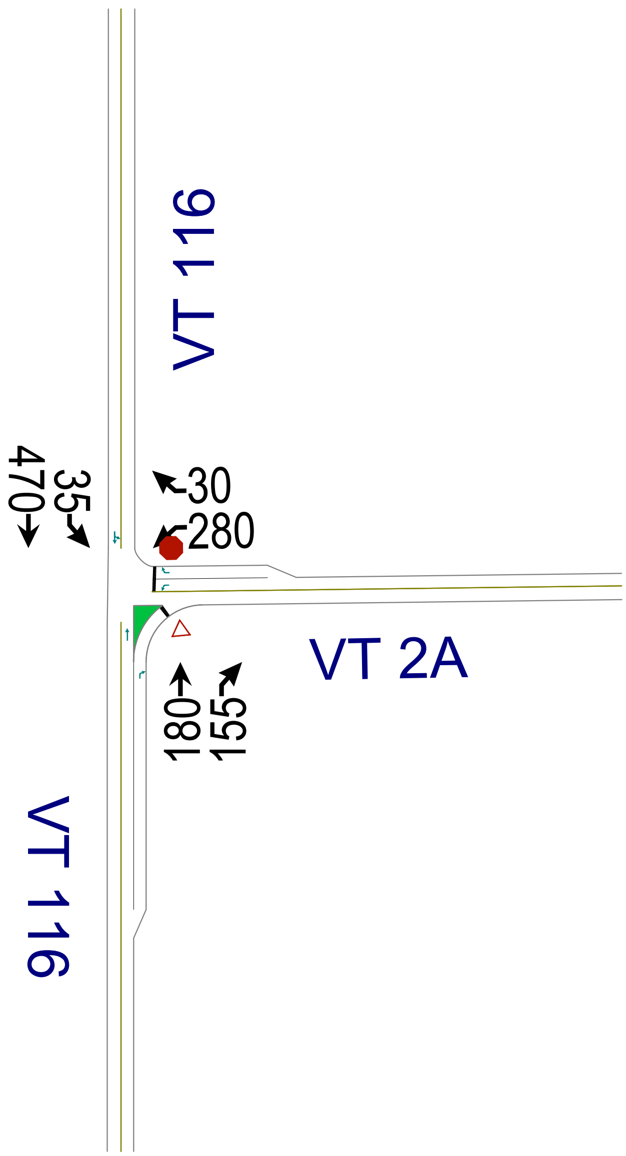
APPENDIX 5

FUTURE 2025 & 2045

PEAK HOUR

TURNING MOVEMENT COUNTS


VT 116
VT 116
VT 2A
10
110
25
130
485
260


VT 116
35
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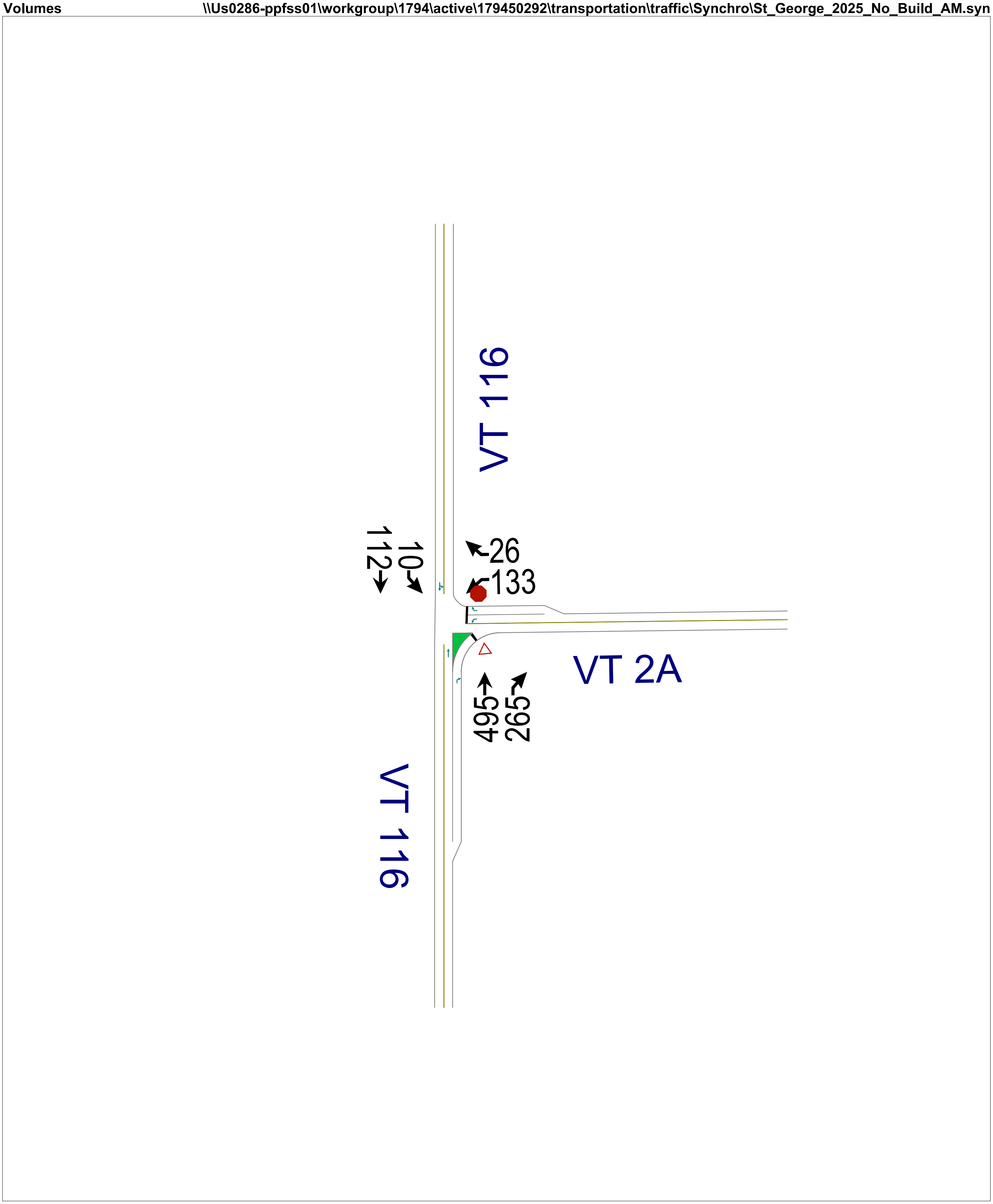
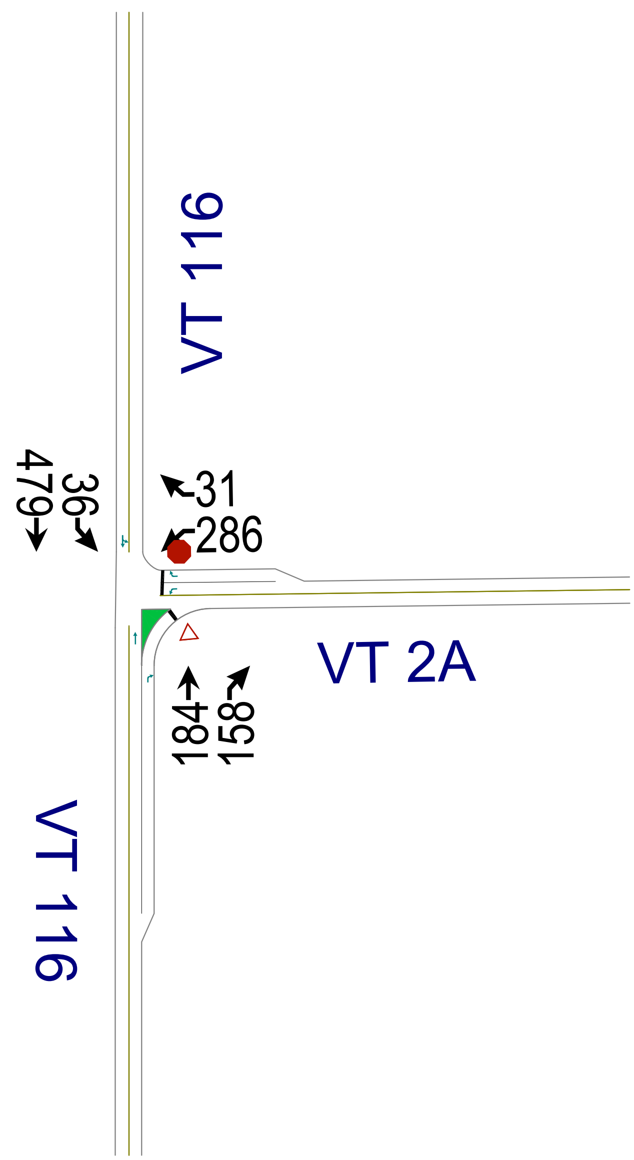
30
280
VT 2A
180
155
VT 116


VT 116
10
112
26
133
VT 2A
495
265
VT 116


VT 116
36
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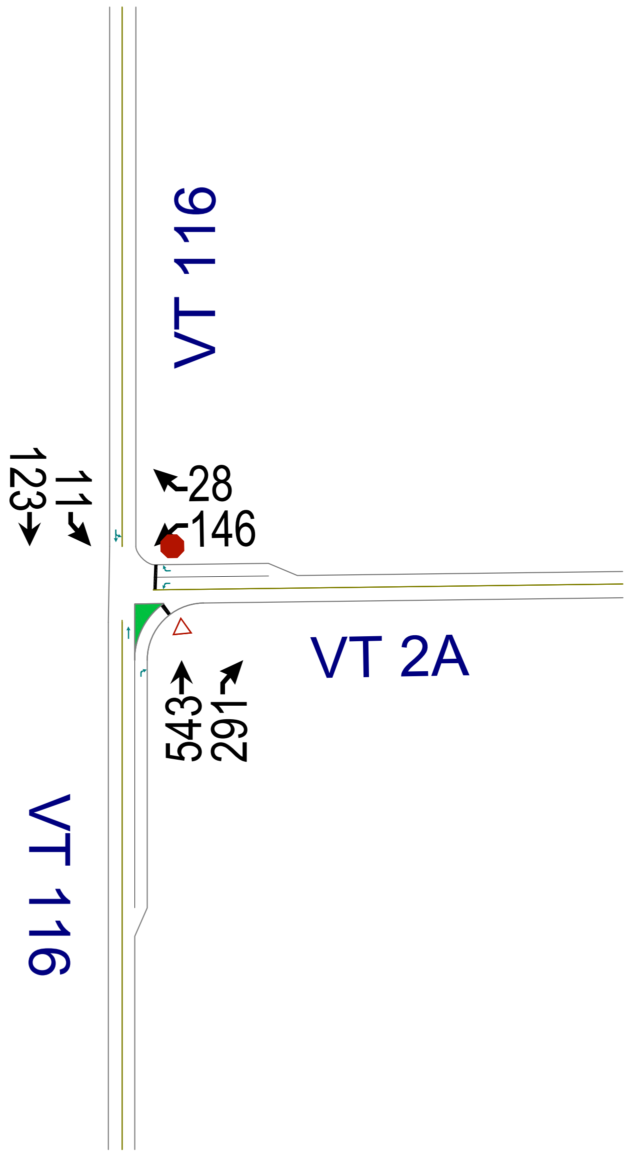
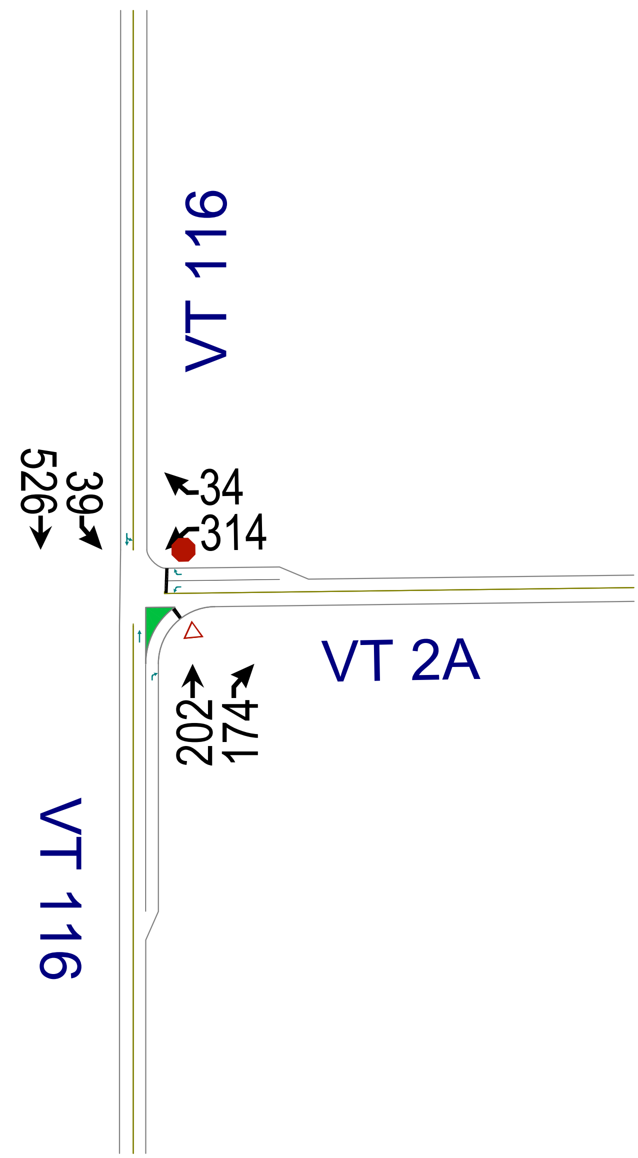
31
286
VT 2A
184
158
VT 116


VT 116
VT 116
VT 2A
28
146
11
123
543
291


VT 116
39
526
34
314
VT 2A
202
174
VT 116